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**MANAGEMENT STRATEGIES AND ORGANISATIONAL STRUCTURES  
FOR PROJECT MANAGEMENT**

Individual Assignment submitted in partial fulfilment of the course

**MINOR DISSERTATION (M6MMD19)**

as part of the degree

**MAGISTER INGENERIAE**

in

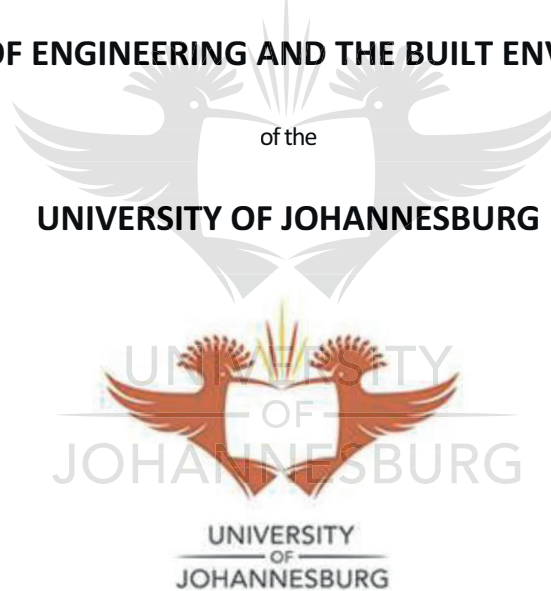
**ENGINEERING MANAGEMENT**

at the

**FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT**

of the

**UNIVERSITY OF JOHANNESBURG**



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## ABSTRACT

The aim of this dissertation is to review and analyse the existing strategies and methodologies of project management relating to management, organisation structures and more specifically their impact on project management itself.

The dissertation will start by doing basic research on project management and the two major institutes that have generated an international standard, namely PRINCE and PMBoK. From here the dissertation will move to explore the different organisational structure how projects are managed in these structures. Next the dissertation will review some of the most basic management principles, and management strategies as well as how they are focussed on projects. Research will consist of various books, journal articles and seminar presanctions being summarised and combined to form the basis of this paper.

The final stage of the dissertation will propose a combined management strategy that assesses the information gathered in the research portion of all sections. The idea behind this proposal will be to allow Engineering Managers to for a basis for managing projects in their organisation. This proposal will in no means be complete as no single set of standards apply to all industries, only guidelines that can be moulded to suit.

The dissertation closes by making basic recommendations to the organisation considered in the case study with regards to all three focus areas as well as a general recommendation. In conclusion the dissertation identifies that there is a need for combining organisational structures and new management styles and principles into organisational structures.

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From a professional perspective, I would like to thank my supervisor, my previous organisations and especially Roytec Global for the insights and experiences received over the past few years that has guided me to the views and insights expressed throughout this paper.

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## LIST OF ABBREVIATIONS

Project Management	PM
Project Management Office	PMO
Project Management Institute	PMI
Office of Government Commerce	OGC
Project Management Body of Knowledge	PMBok
Projects in a Controlled Environment	PRINCE2
Proposed Combined Approach	PCA
Engineering Management	EM
Project Management Maturity	PMM
Project Management Improvement Initiatives	PMIIs
Organisational Structure	OS
Project Management Process Group	PMPG
Contract Engineer	CE
Contract Manager	CM
Head of Department	HOD
Contracts Department	CD
Purchase Order	PO
Scope of Work	SOW
Work Request	WR
Piping and Instrumentation Diagram	PID
General Arrangement	GA
Process Flow Diagram	PFD
Request for Quotation	RFQ
Factory Acceptance Test	FAT
Technical Specification	Tech-Spec
Business Case	BC





Capacity for Engineering Systems Thinking

CEST

Rate on Investment

ROI

Earned Value Performance Management

EVPM



## 1. INTRODUCTION

### 1.1 Research Topic

The main theme of the dissertation will be Engineering Management with a focus on Project Management in Organisational Structures.

### 1.2 Research Introduction and background

From industry experience it has been identified that there exists a large need in various engineering industries for incorporating Project Management into the organisation structure as well as the management style of these organisations. This is due to a disconnect between organisations that are mainly focussed on using projects as a main income stream and the fact that the organisational management style and structure is not project orientated.

The aim of this dissertation is to research a management styles and organisational structures to assist and / or incorporate projects into the everyday organisational operation to improve the success rate of said projects.

### 1.3 Research Problem Statement

There is a large disconnect in most organisations between how the structure allows projects to be run and what the projects require to be completed successfully. A lot of firms have no dedicated methodology with regards to project management and mostly leave it open to interpretation for the Project Manager to deliver to expectation, although sometimes the organisation does require a predefined set of Checks and / or Controls.

The inverse is also true, where the organisation will have a defined methodology for projects based on historical experience from the 80's and 90's that is no longer relevant, practical or best practice in the industry with regards to today's technology and innovations.

### 1.4 Research Objectives

The following objectives will be considered and aimed for the reach a successful study:

1. Review and compare the two main stream PM methodologies
2. Review and examine the existing basic organisational styles to consider the best approach for effective PM
3. Review and examine the existing management principles to consider the best approach with regards to PM

## 1.5 Research Questions

The main questions considered for this proposal is as follow:

1. What is the relevance and impact the two main stream standards, namely PRINCE2 and PMBoK, in existing project organisations?
2. What are the basic organisational structures and are they relevant in project orientated organisations?
3. Can organisational methods be adapted to a more project-based style?
4. What Engineering Management principles can assist managers with the proposed changes

## 1.6 Research Rationale

The main body of research will consider the two international PM methodologies along with the three major types of organisational structures as well as the basic Engineering Management principles.

Relevant books, research dissertations, journals and their articles will be considered in each of the main topics to ensure a broad and accurate understanding and application can be used to create a solid foundation for the proposed Management approach in section 5.

After the research has been completed a Cases study will evaluate an existing engineering firm and evaluate the research results with the findings and make basic recommendations accordingly.

## 1.7 Research Design

Research will be conducted by focussing into each primary area as a starting point, including relevant articles will be reviewed and assessed through the various disciplines. From here the dissertation will consider articles that are more cross bordered to assist in creating the management approach.

The dissertation will generate a recommendation based on the findings of the research and case study and do further research into areas that are found to be lacking to improve and finalise the recommendation in the conclusion chapter.

## 2. LITERATURE REVIEW – PROJECT MANAGEMENT

In recent years, projects have become an everyday occurrence, whether it is in our daily lives, economies or societies. Projects shape and define the way that work is being done in all aspects of our lives and having a strong foundation in projects and their activities will ensure greater success rates (Jensen, Thuesen, & Geraldi, 2016).

When considering project management (PM) it is important to note, that although there are numerous methodologies, that are two main bodies that can be considered as a standard for all these different types of PM. The literature from two will be used to evaluate how PM is seen and maintained from their perspective. The first review will be from the Project Management Institute (PMI) and the second will be from the Office of Government Commerce (OGC) that was developed in the United Kingdom.



Figure 1: Principles of Project Management (Baker, 2018).

## 2.1 Introduction

While considering the basics of PM, it is important to ensure that the definitions of a project as well as that of the PM are clearly understood. A Project is a temporary endeavour, meaning it has a definitive start and end, that is utilised to create a unique deliverable, whether it be a product service or result (PMI, 2013). Project Management is the application of the relevant knowledge, tools and techniques to the different activities that are created in projects (PMI, 2013).

Projects are generally endeavours undertaken to assist organisations to meet certain levels of performance or strategic needs. These projects are normally constrained by the competing priorities in the organisation's project environment (Van Wyngaard, Pretorius, & Pretorius, 2012).

Project management as a methodology is the "planning, delegating, monitoring and control" governing all the actions and personnel in the project to ensure that the project meets its independent and organisational goals (OGC, 2009).

## 2.2 Project Management Body of Knowledge (PMBOK)

The PMBOK is a written standard that can be used across multiple platforms as a guideline. It is however not a complete answer to all problems that may be experienced. The standard is however internationally accepted and widely considered the best platform for the PM profession. The sections covered below will give a brief introduction and explanation into the workings and terms of the PMBOK the generate a wide view of the standard.

### Project Management Framework

The PMBOK considers five basic process groups that any project management process can and should be divided into, namely Initiating, Planning, Executing Monitoring and Controlling and finally the Closing stage. Some of the most important project constraints include the Scope, Quality, Schedule, Budget, Resources and Risk. It is however important to note that these are not the only constraints that can be considered, and they do vary greatly depending on the project product (PMI, 2013).

Over time projects in general have failed to comply completely with the triple constraint, creating a lack in skill and infrastructure development surrounding it. The success rate of projects and the priority given to the triple constraint are in direct correlation to each other,

thus the more effectively it is managed and understood greatly increases the success rate of projects (Mokoena, Pretorius, & Van Wyngaard, 2013).



Figure 2: Due to a growing movement the triple constraint triangle has turned to a diamond (SmartSheet, 2018).

The success for projects within any organisation is greatly influenced by the interpretation of the original triple constraint, and the same holds true for the upgraded diamond version. By utilising an integrated model, the overall organisation management can be utilised as function for PM within an organisation (Van Wyngaard, Pretorius, & Pretorius, 2012).

When considering the management of PM in the organisation structure, it is important to mention the Project Management Office (PMO) which is a body in the organisation that is responsible for overseeing, aligning and assigning projects for the organisation (PMI, 2013).

Most of the time PM takes place in environments that is much broader than the project itself. This means that the project forms part of a bigger picture and understanding the bigger picture and aligning with the goals and methodologies of the organisation a project will have a greater chance of success (PMI, 2013).

The lifecycle of a project is defined as a set or collection of sequential events, but these events can overlap and are project specific. The number of these events or phases is determined by the control needs of the organisation.

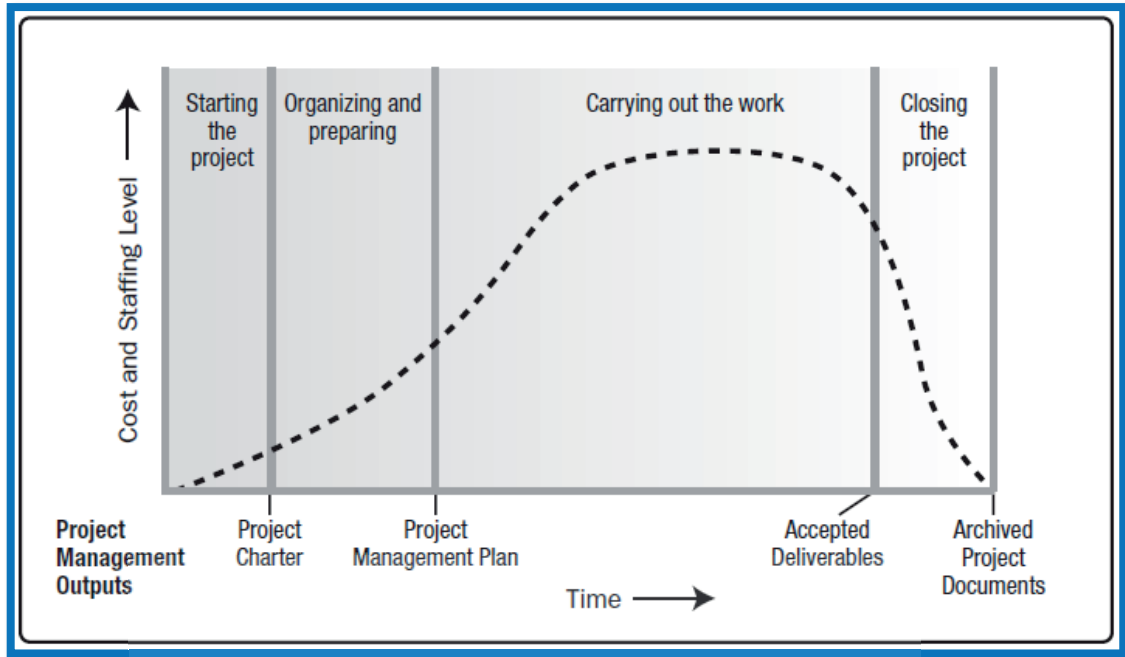


Figure 3: Typical Project Life Cycle Structure (PMI, 2013)

All projects, independent from their type or size, can be mapped as per Figure 3: Typical Project Life Cycle Structure, and can be broken down into the following cycle structures, as per (PMI, 2013):

- Starting or Initiating the project
- Organising and preparing
- Completing project work
- Closing the project

When considering the difference between projects and normal organisational work it is important to note that they both do share similar characteristics, and that projects may be utilised to accomplish organisation work. The main difference is that normal operations are ongoing and produce repetitive work or results.

#### Organisational Influences and the Project Lifecycle

How an organisation is constructed carries a large influence on how projects are performed within the organisation itself. These can include the culture, structure and styles of management. PMBoK defines the ability of an organisation influence a governance of projects the PM Maturity level (PMI, 2013).



There are many different types of organisations and each will have a different impact on projects and their management. These structures will be defined later in the document in more detail.

Table 1: Influence of Organizational Structures on Projects (PMI, 2013).

Organization Structure Project Characteristics	Functional	Matrix			Projectized
		Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Low	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Low	Low to Moderate	Moderate to High	High to Almost Total
Who manages the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

Stakeholders can be either individuals or groups that may have a direct or indirect impact on a project itself, or the project may have a similar effect on the stakeholder. Managing the expectations of stakeholders can become a challenge to any PM as they are normally not aligned to each other and this will be critical to the deliverables and success of the project. Governance allows organisations to constantly control projects to ensure that they are completed to their full potential and aligning them to the organisational strategy (PMI, 2013).

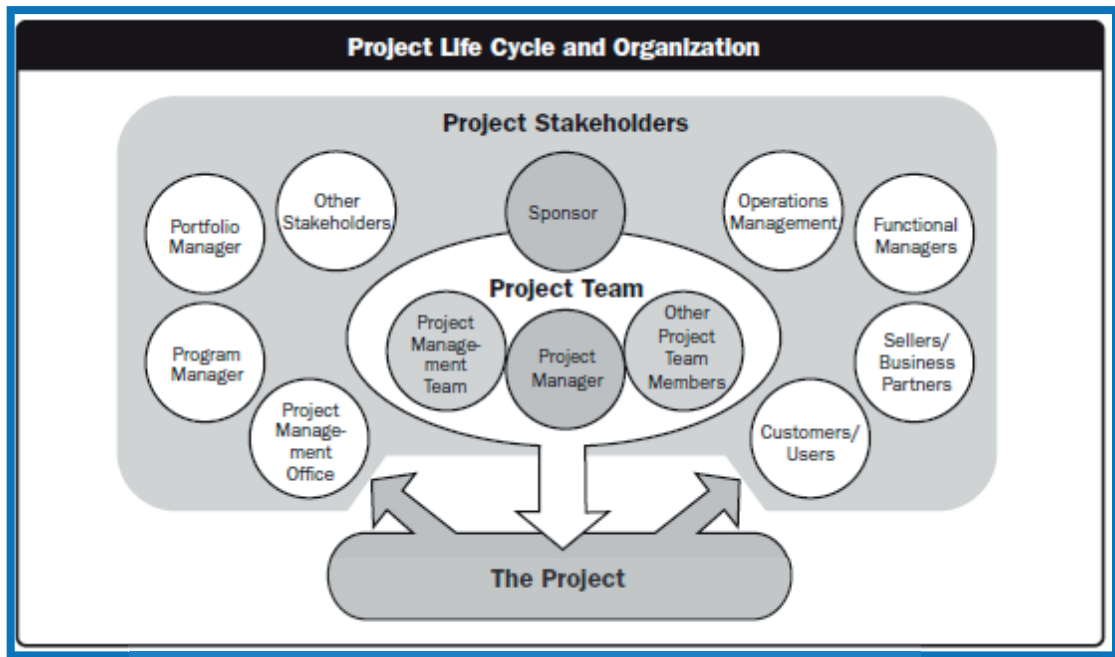


Figure 4: The Relationship between Stakeholders and the Project (PMI, 2013).

Project teams comprises of all the individuals that work together on the duties of a specific project. These can include individuals that do project related tasks but are not necessarily involved with the management of the project itself, being full – or part time (PMI, 2013).

Each project can be broken down into different phases / cycles throughout its lifetime. These phases combine to form the Project Life Cycle. These phases follow one another, and the status of each phase can determine the progress and status of the project. These phases can also be sub-divided into smaller tasks that are required to complete the phase itself. It is important to note that phases normally require their individual predecessor to be completed before it can start (PMI, 2013).

#### Project Management Processes

Project Management is defined as the application of tools, skills, techniques and knowledge to the required activities of a project to meet its requirements. To ensure the success of any project PMBoK identifies 5 steps that the project team needs to complete and acknowledge (PMI, 2013):

- Selecting the required processes
- Use a defined approach

- Establish communication channels and maintain constant communications with all relevant stakeholders
- Manage and comply to each stakeholder's requirements and expectations
- Balancing the competing constraints of the project

Further to these stems, PMBoK defines 5 Project Management Process Groups into which all process can be broken down into. These PMPG's are (PMI, 2013):

- Initiating
- Planning
- Executing
- Monitoring and Controlling
- Closing

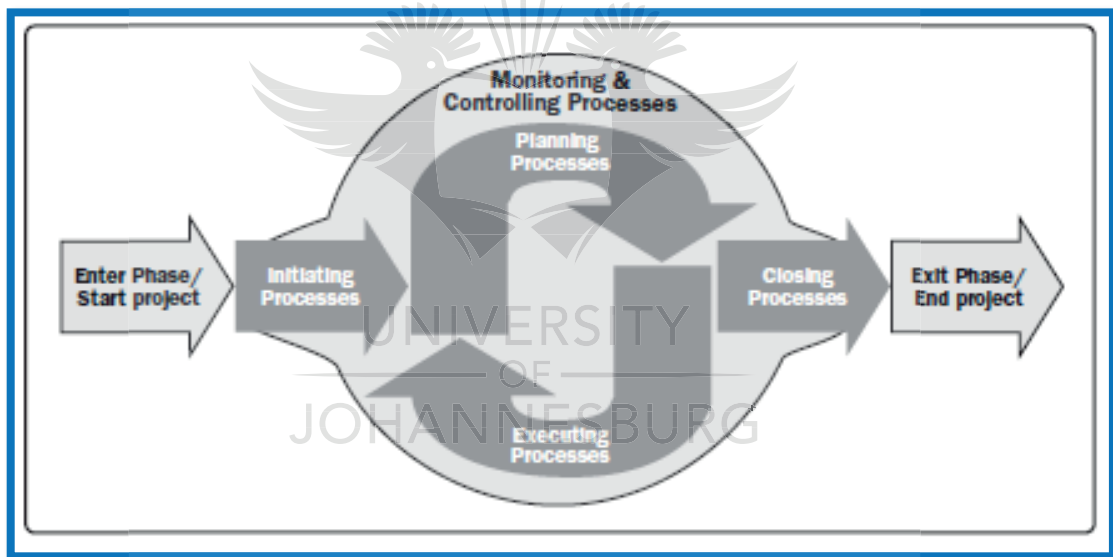


Figure 5: Interactions between the Project Management Process Group (PMI, 2013).

Each of these groups will interact with each other in some point in time within the project phases, as can be seen in the figure below.

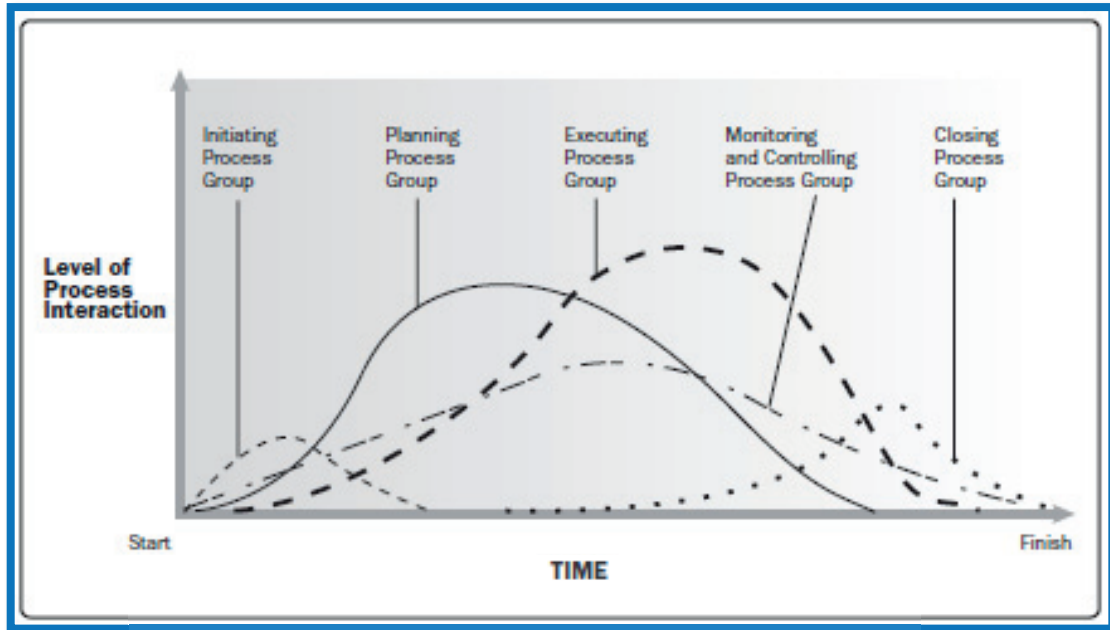


Figure 6: Interaction between the Process Groups in a Project Phase (PMI, 2013).\

Finally, this section identifies the PM Knowledge Areas as identified by PMBoK. These are the major points of consideration when looking at all projects. Each individual area will not guarantee the success of a project on their own but rather a holistic view of each item within the Project Life Cycle.

These areas for the core of the PMBoK standard and are listed as (PMI, 2013):

- Project Integration Management
- Project Scope Management
- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resource Management
- Project Communications Management
- Project Risk Management
- Project Procurement Management

Project Management Process Map

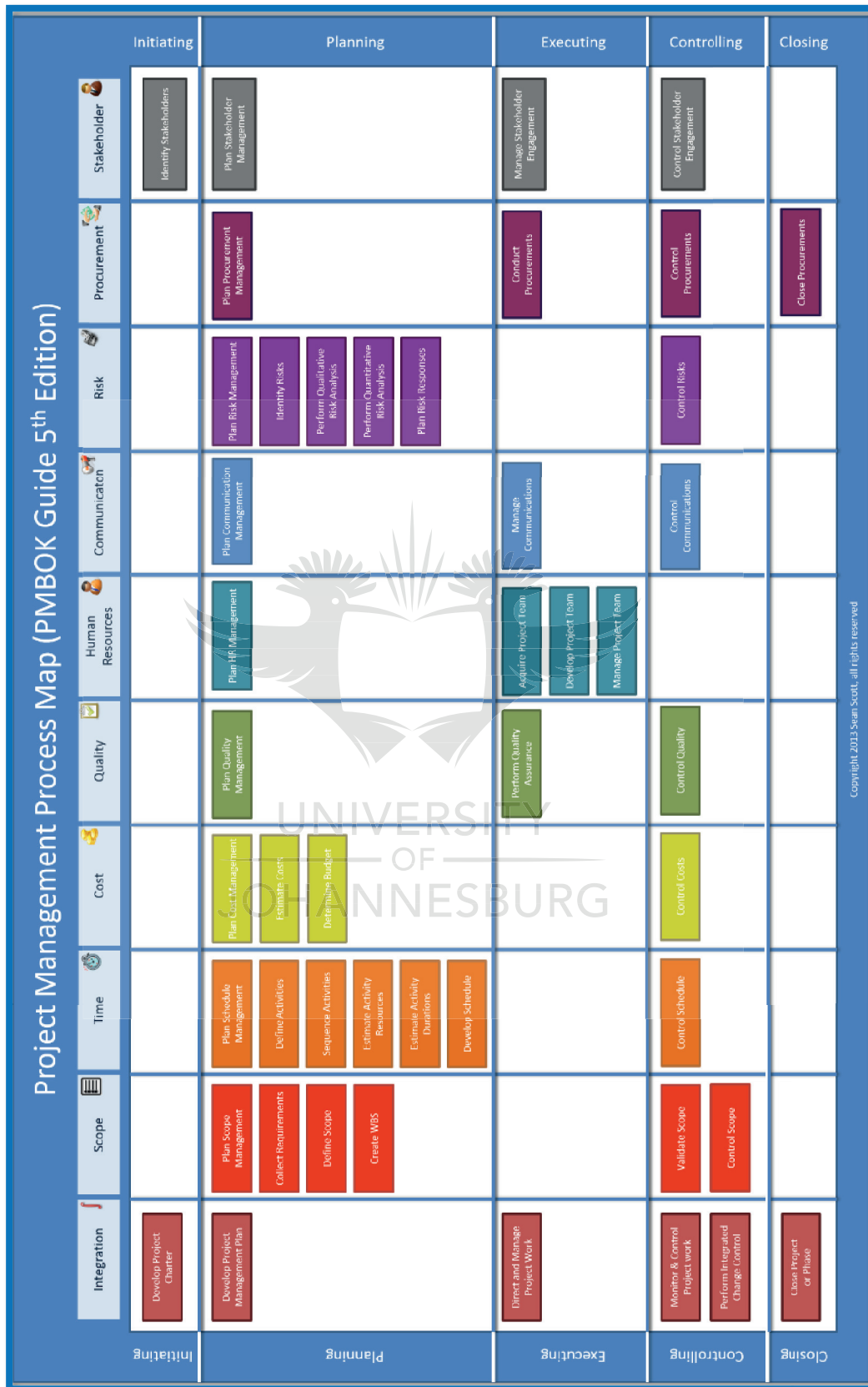


Figure 7: PMI Process Map (Scott, 2015).

### 2.3 Projects in a Controlled Environment

Projects in a Controlled Environment (PRINCE2) is a philosophy structured around the experienced gained over thousands of executed projects, form all organisational and project team (OGC, 2009).

#### Introduction

Projects can also be a temporary miniature organisation that is only created to deliver one or more of the organisational products according to a predefined organisational business case (OGC, 2009).

Projects mainly differ from normal day-to-day organisational activities because of the following core characteristics:

- Projects are generally a way by which organisations introduce *change*
- Projects are only *temporary* in nature
- Projects involve teams comprising of different sills, they are thus *cross-functional*
- Each project is *unique* in its nature because of the varying contributing factors
- All projects contain a certain extent of *uncertainty*

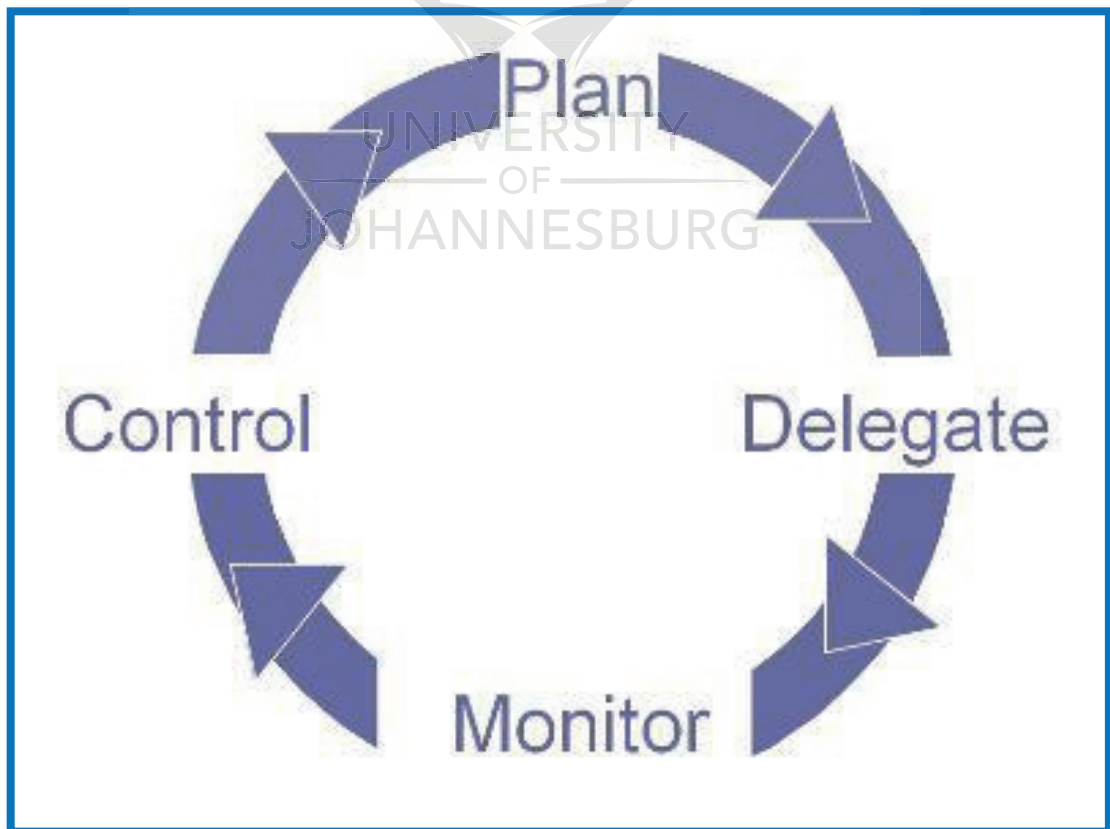


Figure 8: PRINCE2 Project Management Cycle (OGC, 2009).

Following the PRINCE2 philosophy, there are six major aspects that a PM needs to control to ensure projects are executed successfully, these are (OGC, 2009):

- Costs
- Timescales
- Quality
- Scope
- Risk
- Benefits

The PRINCE2 philosophy has seven principles that are universal, self-validating and empowering when used to govern projects. These principles are (OGC, 2009):

- Continued business justification
- Learn from experience
- Defined roles and responsibilities
- Manage by stages
- Manage by exception
- Focus on products
- Tailor to suit the project's environment

#### PRINCE2 Themes

As with PMBoK, PRINCE2 also has core knowledge areas, or themes as they are referred to, that are used to describe the individual broad-spectrum aspects on PM. These must be continually managed and maintained to ensure success on each project. These themes are (OGC, 2009):

- Business Case
- Organisation
- Quality
- Plans
- Risk
- Change
- Progress

For the purposes of this dissertation and its focus, the dissertation will only focus on in-depth research and evaluation into the Business Case theme.

The Business Case (BC) theme's purpose is to evaluate whether the project is desirable, viable and achievable. The BC utilises the best mix of information for the project stakeholders and organisational board members to evaluate with the project will be viable. This is a continuous effort to ensure that external factors such as market changes are always considered. This implicates that the BC is not a static document or decision, but rather an ongoing endeavour until the project is finalised or discarded (OGC, 2009).

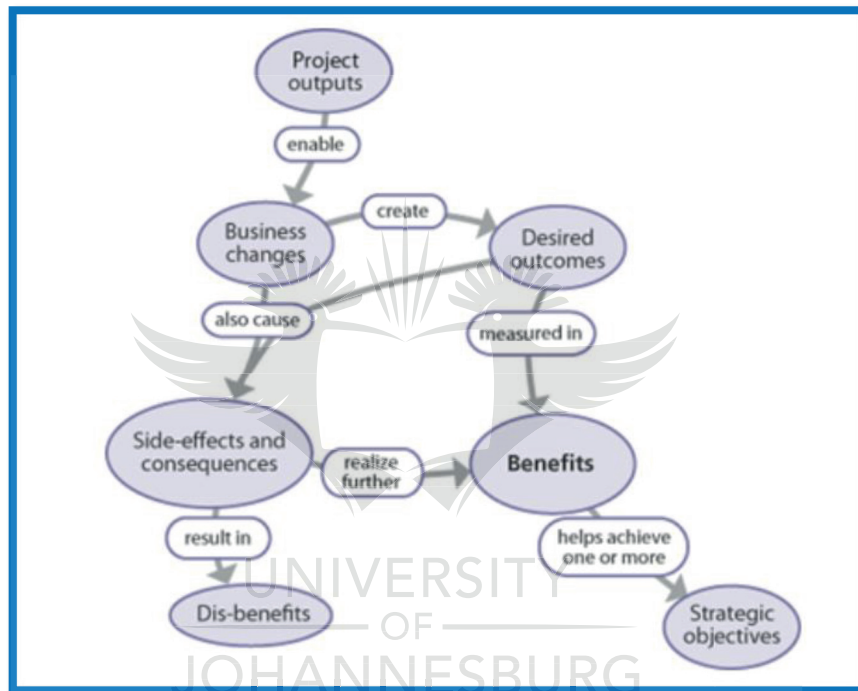


Figure 9: Relationships between outputs, outcomes and benefits (OGC, 2009).

Each project has different objectives and goals, and these will determine the nature of the project. Depending on these objectives, the project will be evaluated and classed differently, for example:

- Compulsory projects
- Not-for-profit projects
- Evolving projects
- Customer / supplier projects
- Multi-organisation projects.



PRINCE2 has a set approach to developing a project BC at the start as well as how to maintain and verify the viability of the BC throughout the project lifecycle. These steps are (OGC, 2009):

- Develop
- Verify
- Maintain
- Confirm

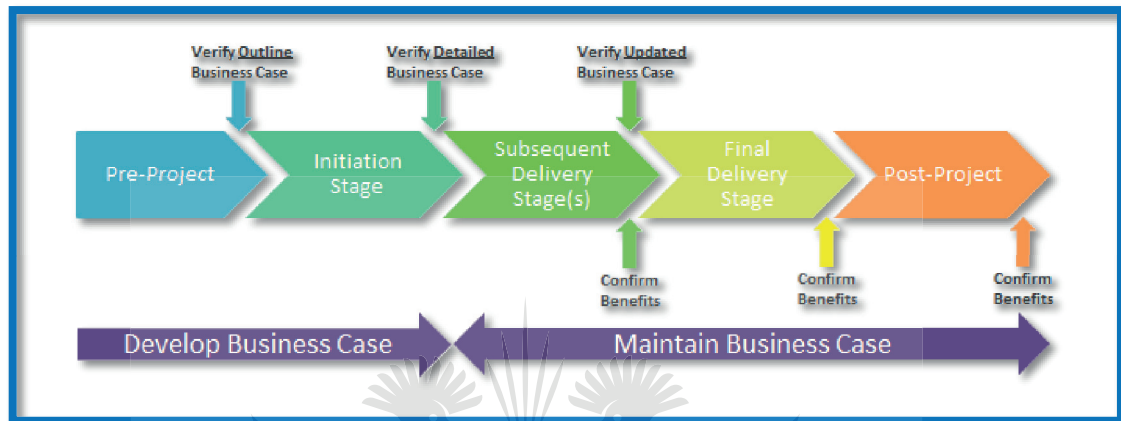


Figure 10: The development of the Business Case (Robinson, 2018).

Finally, this paper considers a general BC that is generated by the PRINCE2 guidelines and typically contains the following (OGC, 2009):

- An executive summary
- Reasons
- Business options
- Expected benefits
- Expected dis-benefits
- Timescale
- Costs
- Investment appraisal
- Major risks

One important consideration is that all roles and responsibilities need to be clearly identified and defined at the start of the project. These will broadly form part of one of the four groups, corporate, project board, PM and team levels. With all team members clearly understanding

their roles will ensure everyone knows what is required of them and to whom they will report. This also assists with the optimal use of organisational resources throughout the lifecycle (Robinson, 2018).

PRINCE2 Processes

PRINCE2 is a process-based approach to PM. These processes can be broken down into several structured sets of activities to accomplish set objectives at certain intervals in the project lifecycle. These processes are (OGC, 2009):

- Starting a Project
- Directing a Project
- Initiating a Project
- Controlling a Stage
- Managing Product Delivery
- Managing a Stage Boundary
- Closing a Project

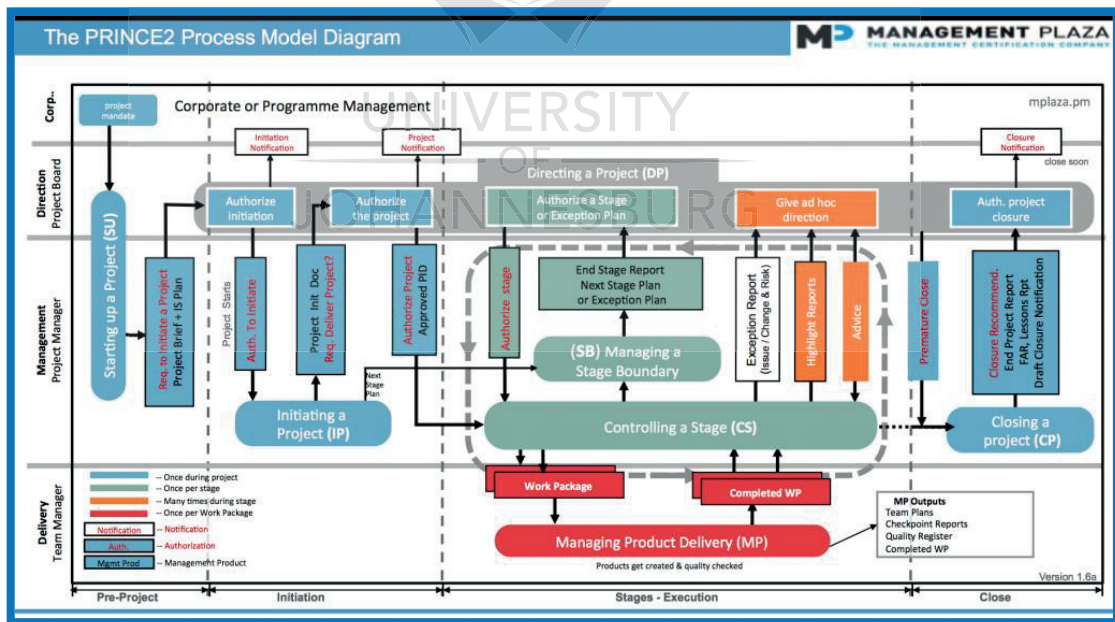


Figure 11: PRINCE2 process model diagram (PRINCE2 Wiki, 2018).

Tailoring PRINCE2 to a Project Environment

The PRINCE2 methodology is not a rigid approach and can be moulded to suite varying project environments and organisational needs. It is important to keep a lesson learned log from previous projects and ensure that these are utilised to customise and improve the future approach, while considering that each project and their situations and objectives are different. (Robinson, 2018).



PRINCE2 Best Practice Model

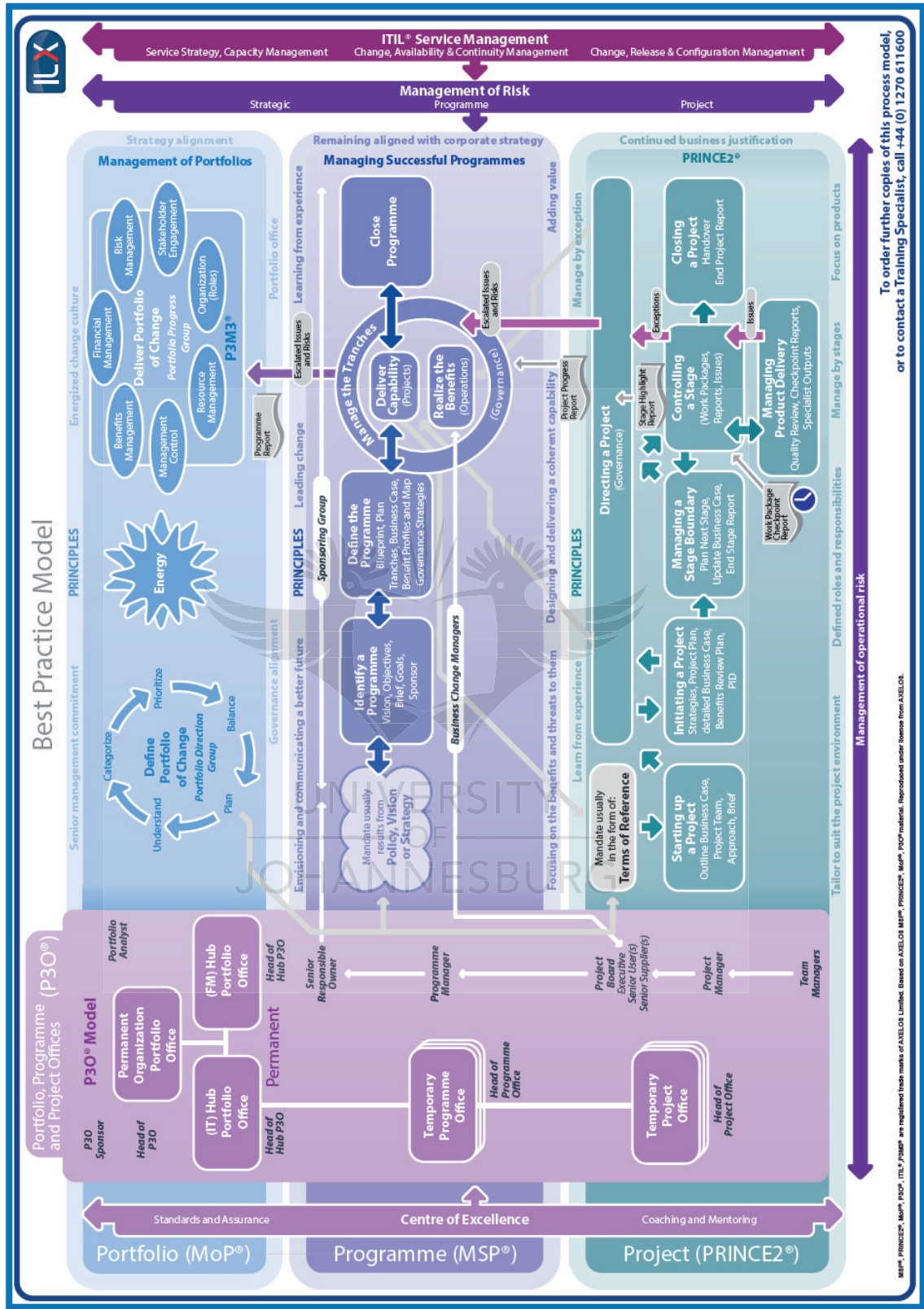


Figure 12: Best Practice Model proposed by PRINCE2 (PRINCE2, 2018).

## 2.4 Main Differences Between PMBoK and PRINCE2

From Sections 2.2 & 2.3 it can be derived that there are quite a few similarities between the two standards. From the outline of the two standards it can also be noted that PRINCE2 can also be used to supplement the PMBOK, instead of competing against it. This is due the fact that although both standards are highly detailed and descriptive, both cover sections where the other is lacking in. These differences as highlighted by PRINCE2 can be found in **APPENDIX A**



### 3. PROJECT MANAGEMENT IN DIFFERENT ORGANISATIONAL STRUCTURES

The second main area of focus of this dissertation is to review the most commonly used project focussed organisational structures, and then identifying the best suited structure to manage PM from an EM perspective. These structures are required for the organisation to supply resources and control for projects, this section will review these structures, along with their individual impact on PM.

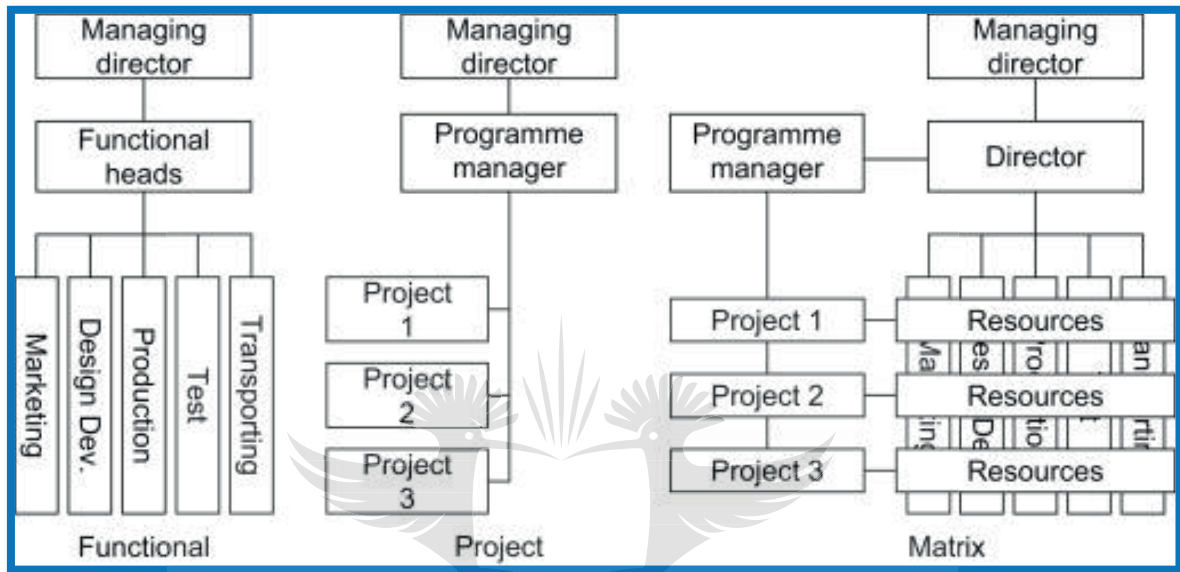


Figure 13: Three types of basic organisations (Lester, 2017).

In most instances organizational design has not been clearly researched, although it has great support and interest in the PM field. Project management has many theoretical inputs into the design of an organisation, but it has created confusion with the amount of terms that describe the organisation and their function itself (Aubry & Lavoie-Tremblay, 2018).

Organizations are characterized as an efficient course of action of work force of offices to achieve the key objective set for the organisation (PMI, 2013). To characterize the Nature of Organizations, one requires the contribution of unmistakably expressed essential points of the association with all the corporate destinations recorded. The Functions of Organizations will rely upon the cooperation between various offices or divisions in that.

A cautiously viewed Organizational Structure is fundamentally essential for any business, and in addition a necessity to expand the business shot of progress. While setting up the hierarchical structure it is essential to consider both the logical and social elements of the said business. It is

basic to survey the accompanying viewpoints previously making the hierarchical structure; authoritative attributes, connections, rivalry, and execution (Tiller, 2012). At present the definition for the hierarchical structure does not characterize the job that it plays in encouraging or restraining information creation (Izunwanne, 2011).

### 3.1 Functional Organisation

The functional organisation is a traditional model that is best suited to a single process type of operation, like that of a manufacturing line, however this structure does not easily allow for cross-functional coordination that is a necessity for PM. The basic problems identified when trying to implement PM into these organisations are the mistrust between the functional groups and the creating of appropriate project teams and the structure thereof. These problems are primarily a resistance to change and thus is more a “people” problem than a problem with the system of structure itself (Payne, 1993).

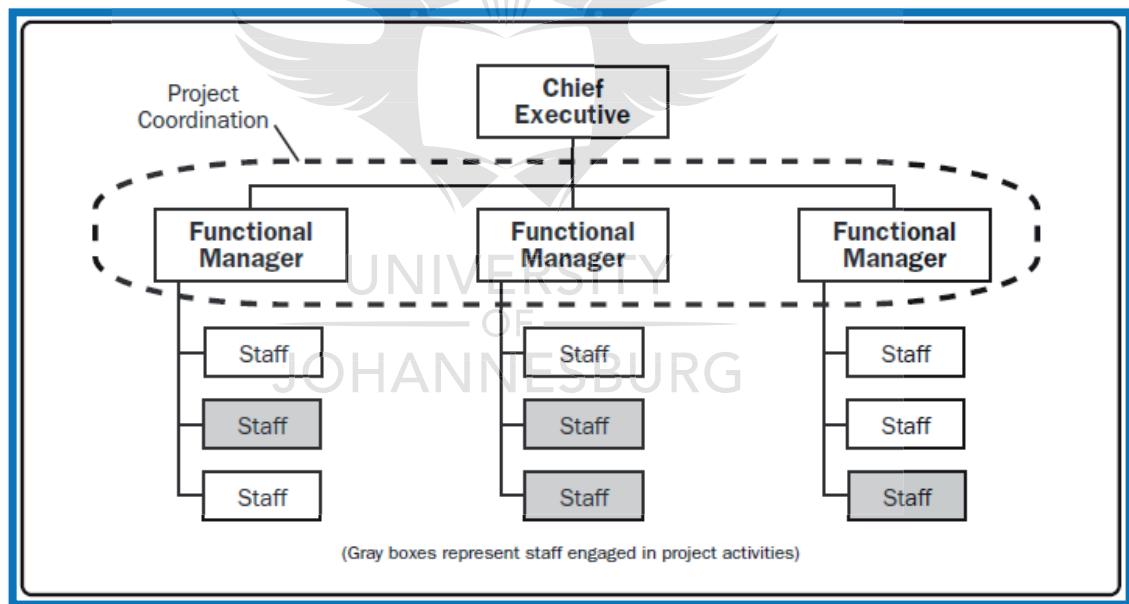


Figure 14: Functional Organization (PMI, 2013).

### 3.2 Project Organisation

The opposite from functional organisations, in terms of PM, the project organisation as the name implies focused on PM. Up until recently little research has been completed on how these organisations translate internal and external experiences to improve their PM strategies. From previous research and case studies there has been a correlation between

adaption of stronger PM principles by an organisation and the improvement of management practices accordingly. This process only happened over a period as senior management required a better understanding of these principles and how to adapt the management strategy. Adapting these strategies increases the effectiveness of the organisations PM practices (Kwak, Sadatsafavi, Walewski, & Williams, 2015).

The project organisation can be viewed as a innovative structure that uses projects and their activities to define and develop the organisations culture and strategies. Structures as these have segments into which they can be broken into, “namely values structures and people”. This structure is defined as utilising a variety of management disciplines at the same time (Gemünden, Lehner, & Kock, 2018).

Although organisational structure design is an established research field the understanding of the project organisation is very limited (Miterev, Mancini, & Turner, Towards a design for the project-based organization, 2017).

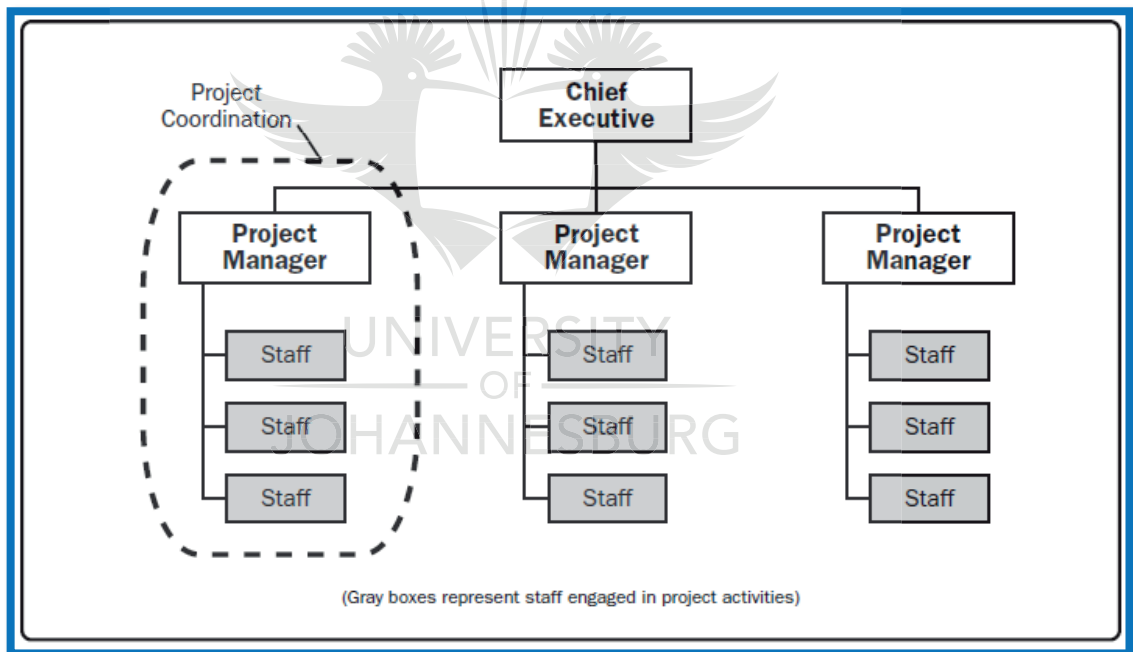


Figure 15: Projectized Organization (PMI, 2013).

This leads to the conclusion that although the projectized organisations will have a strong impact on projects, they may be lacking in other areas. This will cause complications when moving over from the traditional structures and may cause irregularities.



### 3.3 Matrix Organisation

A matrix organisation can be defined as an organisation that utilises a multi-command system, including the supporting structures, culture and behaviour. This structure can also be described as a mixed or overlapped structure with the interdependencies between functional groups and project managers (Ford & Randolph, 1992). The figure below indicates the major differences between this matrix, functional and product organisational structures and the relative influences they share.

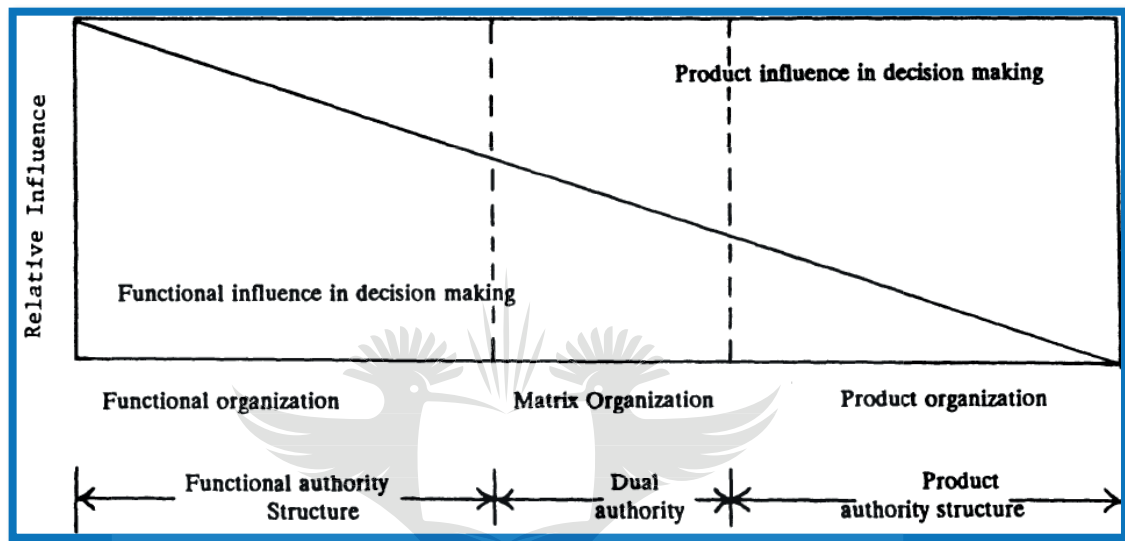


Figure 16: A continuum of alternatives between structures (Ford & Randolph, 1992).

There are numerous different types of the matrix organisation, these types can be as simple as the intercommunication channels between Functional managers or more to the topic of this dissertation to project teams that consist of members of members from varying departments (Pretorius & Taylor, 1986). The matrix organisation essentially means that the teams are focussed on their individual tasks from the project start to end. These teams are led by project leaders, who has similar authority to a functional manager with regards to the project itself (Walden, 2008).

The matrix organisation is most likely the most common organisational structure to date for project orientated organisations, as it offers the least disruptive environment for the functional divisions. All employees allocated to a specific project will be reporting to the PM to ensure they meet the three fundamental project criteria, i.e. time, cost and quality. All this is concurrent with the individual employee's departmental manager to review their performance according to the standards of the department (Lester, 2017).

The major advantages of a matrix organisation are (Lester, 2017):

- Staff can be allocated to different projects if delays occur, instead of the organisation battling with unused resources
- All lessons learned within the different departments are quickly and effectively transferred to all projects
- Staff does not have to be moved around in the organisation, as they will work independently in their departments
- Staff members can still strive for their individual career paths
- Project changes can be handled swiftly with minimal disruptions to everyday duties.
- Lastly, the PM will have the ability to expand or reduce his project team as is required during the project lifecycle

Although there are several advantages to a matrix organisation, similarly there are negative aspects as well (Lester, 2017):

- Project prioritisation can cause conflicts
- The employee's loyalty will be tested due to the dual reporting structure
- Depending on the outlay of departments, communication can be delayed
- Lastly, senior management will spend a considerable amount of time maintaining the balance within the organisation between departments and PM's

Depending on the degree of authority the project manager has over his team, the organisational structure can be call strong or weak. This adds to the conflict in power, but all disadvantages can be managed by senior management and their input and control over the organisation (Lester, 2017).

As an example, the matrix organisation that has been installed at the City of Los Angeles, Bureau of Engineering, has found that the implementation of the adapted strategy has some problems, the overall project performance of the organisation has increased significantly (Kuprenas, 2003).

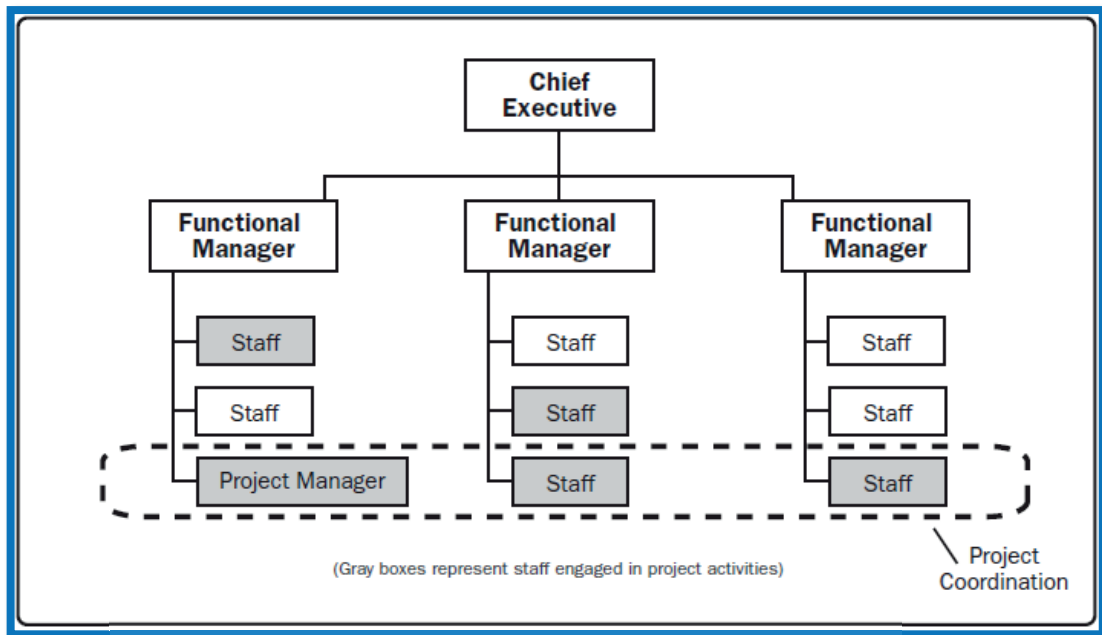


Figure 17: Balanced Matrix Organization (PMI, 2013).

From the research above, this paper concludes that a starting point for structure migration is best suited to the matrix organisation. It not only allows for simpler integration into existing models, but also drastically increases the effectiveness of projects and their activities.

## 4. PROJECT MANAGEMENT IN DIFFERENT MANAGEMENT STRATEGIES FOR THE ENGINEERING ENVIRONMENT

The third major focus point of this dissertation is to review the most commonly used managerial topics, principles and theories and deduce the most effective approach from an EM perspective.

### 4.1 Important Management Topics and Principles

Engineering Management (EM) is a relatively new field of engineering, and accordingly it does not have a wide range of definitions allocated to it. The EM field requires the individual to apply certain engineering principles, tools and techniques along with certain managerial functions to managerial problems (Kahraman & Onar, 2015).

Communication forms part of our daily lives, and communication for an Engineering Manager may include not only employees, but also stakeholders, suppliers etc. (Meid, 2015). Communication has always been viewed as an essential required skill, but only in recent times have the specific effects from a leadership perspective gained incredible ground in the field (Jacqueline Mayfield, 2016). The distinction among efficient and effective communication has turned out to be increasingly evident in varying disciplines and is regularly underestimated, both of which having different methods assigned with diverse techniques allotted with various results relying upon the circumstance. Communication majorly affects the achievement or failure of any project, contingent upon how well it is managed (PMI, 2013).

When considering EM, Personal Management is viewed as promoting oneself as an example to others, particularly to those employees or members that will be overseen. This aspect likewise incorporates self-improvement, by learning from one's own mistakes and assuming liability as opposed to searching for a simple way out of a troublesome circumstance. At the point when a manager comprehends that quality is an essential part of any association; the nature of human pride and ability development will be comprehended (Singh, 1996).

The Integrated Management Model is a framework that involves consolidating or gathering a part of business components. The quicker and progressively productive this integration gets actualized, alongside persistent enhancement, the sooner the business will reach a competitive advantage. From the distinctive perspectives of various researchers, it can be concluded that there is no single answer for various associations to indicate specific integration (Rebelo, 2014).

The Schools of Management Thought can, according to Dr H. Koontz, be divided into six schools, each with sound supporting (Philip C. Hicks, 2015).

1. The Management Process School is based on the functions of managers in an organization.
2. The Empirical school, which utilizes the investigation of experience to distinguish the administration procedure.
3. The Human Behaviour School that is produced from the connections between people.
4. The Social Systems School that sees the executives as “social system or system of cultural interrelationships”.
5. The Decision Theory school, that depends on the basic leadership process, or the decision-making process.
6. The Mathematical School that to be a “system of mathematical models and processes”.

A critical aspect for the success of EM is to Manage and Motivate Knowledge workers requires an alternate methodology in management to that of hands-on or blue-collar workers. These specialists, for the most part, go through the greater part of their day working with information or data, and thus require additional inspirational components, such as (Huang, 2011):

- “job complexity”,
- “information processing”,
- “problem solving”,
- “skill variety and specialization”.

Dealing with these laborers “is the process of tracking team member performance, providing feedback, resolving issues, and managing team changes” (PMI, 2013) .

If the accessible systems of an organisation allow the manager to do so, any Potential administrative problems can be caught early enough to be able to negate its effect. This will assist the organisation with optimizing its expenses and budgets (de Felice, Petrillo, & Autorino, 2014). When considering a Management System, it is essential to consider Peter Senge's fifth Discipline and the laws it portrays. These laws, in short these are (Senge):

- “Today’s problems come from yesterday’s solutions”
- “The harder you push, the harder the system pushes back”
- “Behaviours grows better before it grows worse”
- “The easy way out usually leads back in”
- “The cure can be worse than the disease”
- “Faster is slower”
- “Cause and effect are not closely related to time and space”
- “Small changes can produce big results – but the areas of highest leverage are usually the least obvious”
- “You can have your cake and eat it too, but not at once”
- “Dividing an elephant in half does not produce two small elephants”
- “There is no blame”

Leadership can't just be a unique resource or delicate aptitude, since it has a complete direct effect on the required results. The main target for any leader is to ensure results, by assigning work to their colleagues or employees. To be a compelling leader, one should have the capacity to apply a wide variety of styles, contingent upon the circumstances they are working in and the colleagues they are working with. This will guarantee that all individuals are used to their maximum potential (Pandit & Jhamtani, 2011). Research examines directed demonstrates that a great deal of projects may fail if an undertaking supervisor's leadership position is disparaged. This further features the imports of appropriate initiative in a group viewpoint (Anantatmula, 2015).

Underestimating the distinct effect different individuals can have on a Team, the viability of the team will be questioned. For longer time periods, the more assorted a team’s synthesis is, the more negative outcomes can be expected (Cristina Rubino, 2014). Sharing knowledge and experiences within a team requires all members examine the significant data they have with respect to the jobs that needs to be done. Preparing a team will enable individuals to deliver progressively positive outcomes and work more effectively and efficiently (Joan R. Rentsch, 2014). In the construction business, groups are viewed as a very basic integral part of the industry, and along these lines they majorly affect the execution of the industry. While assembling a team, it is vital to consider the jobs and prerequisites of the team as well as for each member require, and in addition their connections with one another. While choosing

individuals as indicated by Belbin's Team Role Theory, the common roles of every part ought to be talked about and considered (Senarante, 2015).

A critical component of the EM field is a carefully planned Operational Management framework that will guarantee all activities are done viably and effectively inside the organization (Anice I. Anderson, 2004). The three noteworthy exercises in operational administration are Process Quality Control (which is a continuous procedure), Process Quality Improvement, and Periodic Process Review and Assessment (Defeo & Juran, 2014).

The principle requirement for Ethical Management originates from the detachment of morals from ordinary business practice. It is hard to see individuals as objects at whatever point they need to investigate subjects with respect to ethics. An individual's feeling of ethics is shaped by the individuals own relationships and connections (Painter-Morland, 2008). Somebody in the professional environment must research the significance for their work that impacts others and dependably hold fast to a solid moral standard (Peterson, 1996). For engineers, they should take care of the specialized issues and in addition the more extensive extent of desires and standards. It is critical to ensure to not lean towards deceptive conduct to meet these expectations (George Geistauts, 2015).

The Strategic Planning Process is characterized as making a lot of ventures by using the associations objectives. This arrangement must incorporate a wide view of the objectives that should be accomplished, and additionally how to accomplish them. This process depends on ability frame senior management and is for the most part finished in advance. There is a reasonable relationship between the workers' perspective of the vital arrangement and the degree to which they feel engaged by the arrangement itself versus the accomplishment of the arrangement itself (Brumm & Drury, 2013).

Although the vision, mission and objective articulations of organisations give some rule to where it is going, these are insufficient on their as the Strategic Management process has increased more endorsement from various engineering firms (Singer & Brown, 1991). A viable technique requires the contribution from the associations top managers to provide a reasonable key guidance and to inspire the arrangement as a management strategy (Ugboro, Obeng, & Spann, 2011).

Procedure Formulation is finished with the aim of producing progresses in the associations' market, and in addition satisfaction of the goals set by the association (Moghaddam, Nedaei,

Sahafzadeh, & Hosseini, 2013). The factors found in the process are (Andrews, Boyne, Law, & Walker, 2009):

- “rational planning”,
- “logical instrumentalism and strategy process absence”, and
- “the strategy content variables are prospecting, defending and reacting”.

The expression "Executing the Strategy" is portrayed best, as the procedure a manager will pursue to actualize the associations set destinations. Every system ought to incorporate an unmistakable vision clarifying how the outcome will be conveyed, in view of best practices (Tucker, 2017). Albeit numerous associations have techniques set up, not very many of them can effectively execute these plans. This failure is for the most part credited to powerless management in the association (Chung, Chao, & Lou, 2016).

Performance Measurement is the foundation of management practices (Muchiri, Pintelon, Martin, & de Meyer, 2010), with a solid hypothetical foundation it decisively affects the execution of a group and its individuals (Henman, 2016). Its goal is to provide (Wright, 2005):

- “measurable outcomes”,
- “setting performance targets”,
- “regularly monitoring performance”, and
- “working toward quality improvement”.

By utilising performance measure, a firm can utilise Performance Control to evaluate results of its internal projects, to line up with the organisations strategy. When looking at the organisations performance, Performance Evaluation is a management system that is considered one key areas. Without it continuously enhancing or training the organisations employees, achieving the strategic goals set will be unthinkable. (Yunting, 2012)

As a rule, innovation can be portrayed as the procedure of information transformation (Penide, Gourc, Pingaud, & Peillon, 2012). By using the outcomes accumulated from case studies and interviews completed by Rohrbeck & Gemünden, three distinct Roles of Innovation can characterize and expand the associations limit with regards to innovation. These three roles are (Rohrbeck & Gemünden, 2011):



- “The strategist role”,
- “The initiator role”,
- “The opponent role”

The Strategic Management of Innovation is a major endeavour in the advancement of any organisation. It centres around the practices that advance development and is essentially focused around management and the help they give to the innovation process (Penide, Gourc, Pingaud, & Peillon, 2012).

If the best practices can be depicted as a set of various examples of process, at that point Innovation Best Practices is best portrayed as the required strides in the development procedure. The connection between business procedures and general development forms, portrays the prescribed procedures that is suited for the required business process (Penide, Gourc, Pingaud, & Peillon, 2012). Existing literature with respect to advancement of the executives discloses to us that these accepted procedures are unique to every association (Blindenbach-Driessen & Van den Ende, 2010).

Creating innovation, and examination into new items, is continuously and increasingly becoming risky, expensive and dependent on various information bases, all through different associations. Because of these reasons, a wide range of organisations are subcontracting development to their suppliers, although these providers might not have the required information for the said improvement. Surveying the capacities and defining clear objectives may help enhance the quality of these improvements (Handfield & Lawosn, 2007). These advancements are likewise required to keep associations aggressive in the market and may likewise incorporate the enhancement of existing items (Klus & Killingstad, 1988).

## 4.2 Systems Thinking

Systems Thinking is critically important to consider for a managerial and project perspective. It consists of five disciplines, Systems Thinking, Personal Mastery, Building Shared Visions, Team Learning and Mental Models. This thinking methodology is a very successful approach when solving complex and dynamic situations (Elias, 2017). This approach can be better understood when it is considered as a multi-disciplinary approach to problem solving (Shaked & Schechter, 2016).

Systems thinking is widely considered a very important ability for engineers who are taking a leadership role / position in complex projects. In numerous organisations project engineers with a clear understanding of systems-thinking enables these organisations and the relevant PM's to allocate the best engineers for the respective jobs and project components that require a Capacity for Engineering Systems Thinking (CEST). Although this is a critical process there is no process defined to evaluate an engineer's capacity or systems thinking (Frank, Zwikael, & Boasson, 2007).

Organisations are continuously placed under more constraints and are finding it harder to continuously increase their Rate of Return (ROI) for shareholders of the organisation. Although there are numerous paths that may be taken to increase the ROI, like new products and market diversification, these are all dependant on customer satisfaction. One possible solution to this problem is continuous improvement of existing products, that could lead to improved profit margins and greater levels of customer satisfaction. System thinking, and system dynamics plays a large role in continuous improvement and is greatly affected by the 'feedback causality' system (van Dyk & Pretorius, 2014).

Phases
Phase 1: Problem Structuring
Phase 2: Causal Loop Modelling
Phase 3: Dynamic Modelling
Phase 4: Scenario Planning and Modelling
Phase 5: Implementation and Organizational Learning

Table 2: Phases of the Systems Thinking and Modelling Methodology (Elias, 2017).

Based on the reductionism theory the best solution for understanding complex problems is to understand and solve each individual smaller problem and / or occurrences that creates the complex problem. In stark contrast to this the Systems Thinking approach is a holistic view

of the problem, that considers each individual problem to be part of, or at least connected in some manner, to the complex problem itself meaning that the *“the whole is more than the sum of its parts”* (Shaked & Schechter, 2016).

Over the past few years numerous researchers have demonstrated how the correct implementation and application of systems thinking has increased the efficiency of managers with handling complex situations in a wide range of areas. Because these researchers have also found a correlation between successful project performance and Systems thinking itself, systems thinking can also be considered as an effective methodology for business management (Shaked & Schechter, 2016).

### 4.3 Managerial Aspects for Effective Project Management

While considering how to manage and maintain effective project management, there are a few important considerations that need to be accounted for. This section describes some of the more important aspects identified briefly that can be utilised from a manager’s perspective.

When evaluating projects, it is important to accurately value the project and to consider and incorporate the risk preferences for the project stakeholders. One of the methods to do evaluation, is by using “Real Options”. These are easily available approaches that assist with the valuations of flexibilities in projects, although they do have shortfalls when considering the organisations risk appetite. Because of this shortfall, researchers suggest that the risk perspective should be estimated for each real option as well as the PM. A study completed by Andalib, Tavakolan & Gatmiri earlier in 2018 proposes such an approach for project based on economic behaviour, utilising three defined theories, namely (Andalib, Tavakolan, & Gatmiri, 2018):

- The binomial lattice method,
- Monte-Carlo simulation, and
- Cumulative prospect theory.

Another possible approach is the Earned Value Performance Management (EVPM). This approach was established and defined as a “Cost / Schedule Control Systems Criteria” by the USA in 1967. It has mainly been used in defensive projects with large budgets going over R 100mil. In recent years the EVPM is being implemented by the private sector for large scale

projects. Research completed by Vertenten on a target group of PM's shows that the concept is in some form or another already being utilised within the SA Construction industry, although all the benefits were not being fully utilised at the time (Vertenten, Pretorius, & Pretorius, 2012).

When considering the success and continuous growth of an organisation, it is important to strive for sustainably, to optimise the organisation's ROI's and to refine a strong competitive market advantage. By implementing, monitoring and controlling the optimised management strategies efficiently an organisation has a greater chance to achieve its designation objectives. If these strategies are not controlled appropriately it may cause losses due to additional expenditure as well as schedule slippages and decreased market valuations (Naidoo, Pretorius, & Marnewick, 2015/6).



## 5. PROPOSED COMBINED MANAGEMENT APPROACH

Based on the research completed for project management strategies, organisational structures and management principles, it has been identified that a composite organisational structure with modern management principles will be the most successful in managing a project orientated organisation.

When considering any possible adjustments to existing structures or PM strategies, it is important to consider the Project Management Maturity (PMM). This topic was widely considered at the start of the new millennium and a variety of models was published during this time. Many acting Project Managers reviewed the research mostly positive at the time, but many organisations received little return when implement these models. The topic is still widely cruised and analysed mainly due the narrow focus and mechanistic approach to most models (Görög, 2016).

Research data from Fernandes, Ward, & Araújo suggests that organisations can implement certain useful project management improvement initiatives (PMIIs) based on historical data from different organisations. This is more effective than existing literature on PM, as the implementation appears to be limited, however it must be a starting point before implementing any strategies (Fernandes, Ward, & Araújo, 2015).

### 5.1 Managing Project Orientated Organisations

The organisational structure plays a major role in the success of projects in any organisation, and thus it is critical to be considered when designing the organisation structure itself. Currently it is widely acknowledged that most organisations are complex and that the structure is ever evolving to suit market needs. The complexity comes into play when multiple projects are being executed while performing the regular day to day tasks of the organisation (Aubry & Lavoie-Tremblay, 2018).

Form research it is important to consider and adopt the contingency perspective as a baseline as it utilises the influences of projects on organisations against traditional organisations (Miterev, Mancini, & Turner, 2017).

### 5.2 Project Management Office in Organisations

When considering PM in any organisation, it is important to note that the project management offices, PMO, and the structure thereof will play a major role in the success rate of the organisations projects. If an existing PMO is not delivering the required delivering the required project results the structure might require a reconfigure (Hobbs, Aubry, & Thuillier, 2008).

### 5.3 Identified Composite Organisational Structure

Along with the implementations of a PMO into an organisation, the organisations implementations of best practices for PM is a powerful attribute to their success rate. Organisations are responding efficiently and timeously order to adapt to the rapid changing environment of projects. When developing the PM strategy, it is important to consider the impact and buy in from all relevant stakeholders and employees in the organisation itself. Three important considerations points are (Carvalho, Tereso, & Fernandes, 2017):

- People
- Organizational Knowledge; Processes, Tools and Techniques
- General Management System.

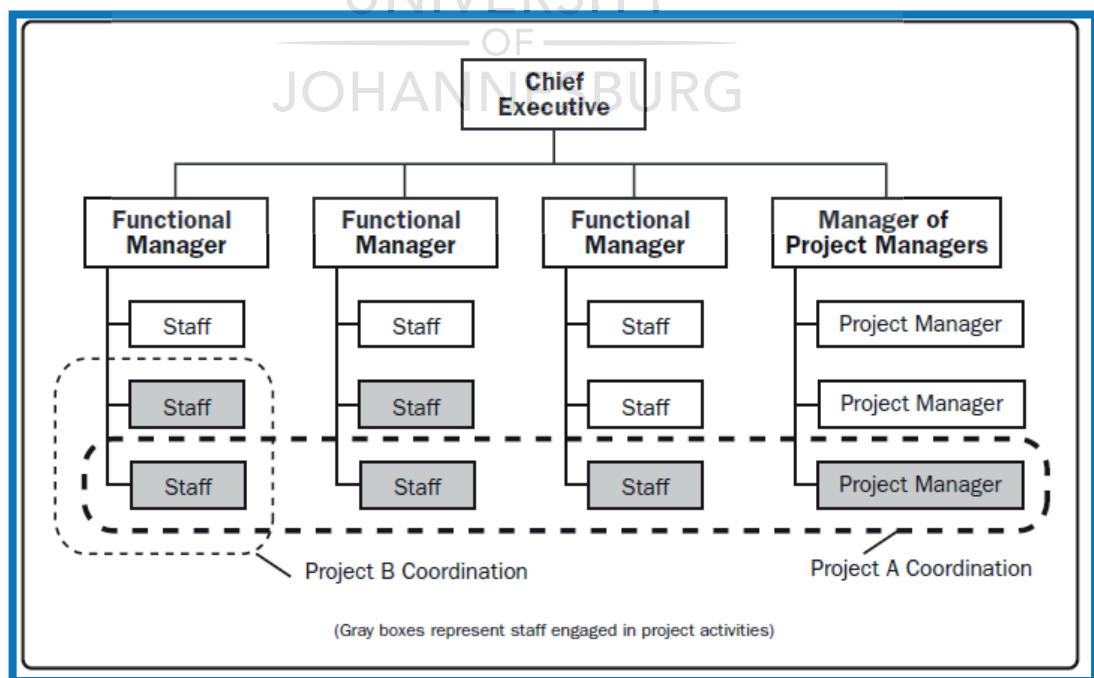


Figure 18: Composite Organization (PMI, 2013).

## 6. CASE STUDY – ROYTEC GLOBAL

The dissertation next reviews a case study based on an existing organisation in the South African market with a strong project focus. The dissertation evaluates the information against the research completed thus far in this document. Based on these observations, there are some basic recommendations, but these can by no means be considered complete as further analysis will be required to test the validity of the proposal.

### 6.1 Background

The organisation is Roytec Global and is a privately owned & managed organisation that prides itself on delivering to their commitments (Roytec, 2018).

The organisation was first established in 2001 as Roymec Technologies but has since been rebranded in 2015 to Roytec Global. The organisation specialises in the supply of Filtration & Separation Equipment and tailored to support African Mining & Industry. They continuously strive for innovative and cutting-edge technologies to provide an ever-improved service to their clients and strives to ensure that they are Leading Equipment Suppliers of thickening, clarification, filtration and flotation equipment (Roytec, 2018). The organisation offers Proprietary Technology in Thickeners, Clarifiers, Multi-Media Filters and Ion Exchange as well as Partnered Technologies for Flotation, Vacuum Filtration and Pressure Filtration (Roytec, 2018).

The organisation strives for a Passion for Excellence by ensuring that the relevant Shareholders are Directors and Managers in the organisation and everyone has a passion for Excellence in Technical Support, Project Delivery and After-Sales service (Roytec, 2018).

The organisations project management reputation has been built on reliable timely delivery according to specification. The project managers (Contract Engineers) of the organisation are empowered and motivated to meet the organisational goals, no matter what the contract requirements may be. The organisations Board regularly monitors updates on Project progress and actively gets involved early if problems arise (Roytec, 2018). The Project Managers and Directors are fully accountable for all decisions and are always available for consultation. A measurement of the organisational success is Client Satisfaction and repeat business with Clients returning for new projects and equipment upgrades (Roytec, 2018).

## 6.2 Organisational Structure

The organisation's full organogram is as follow:

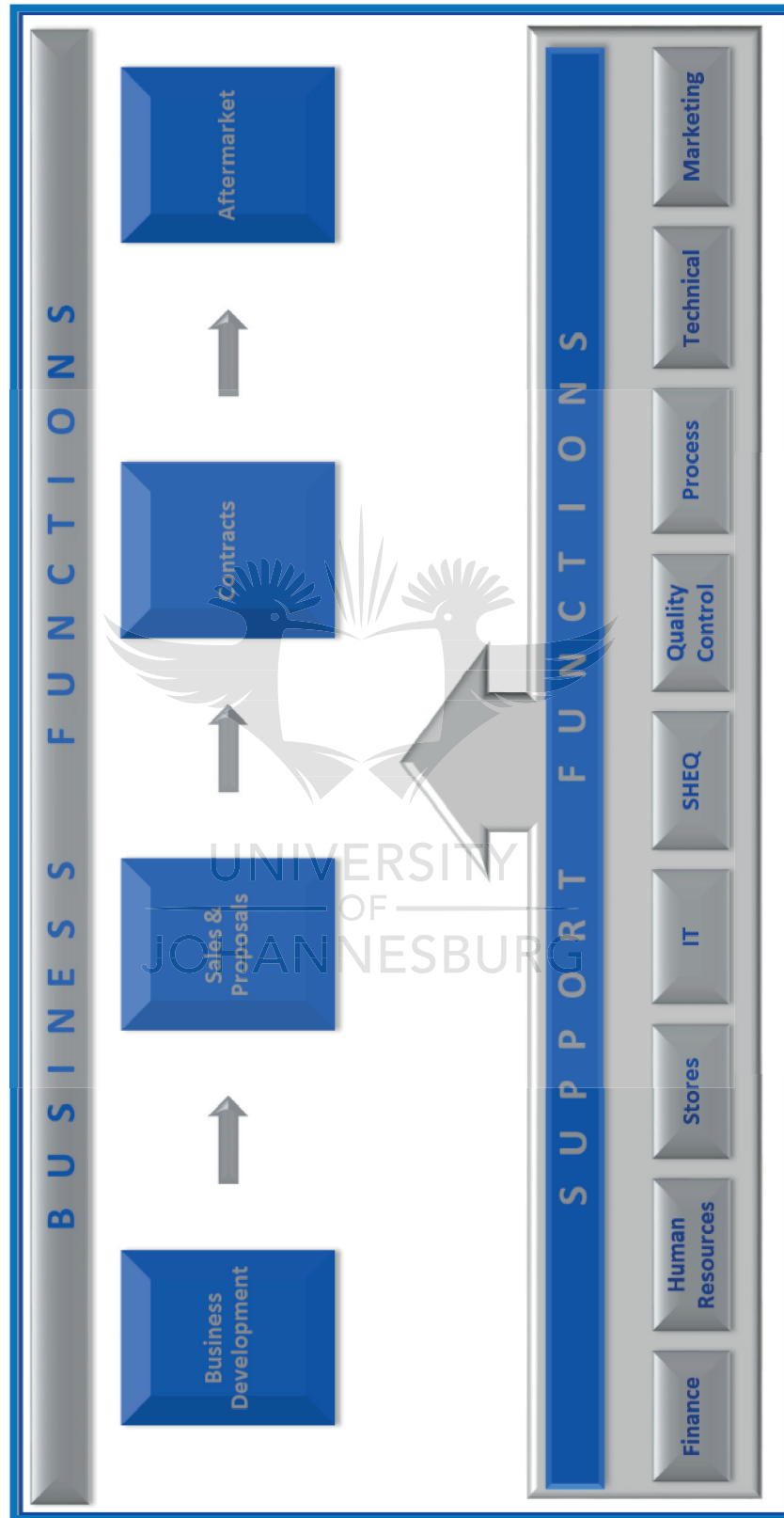


Figure 19: Roytec's main organisational breakdown



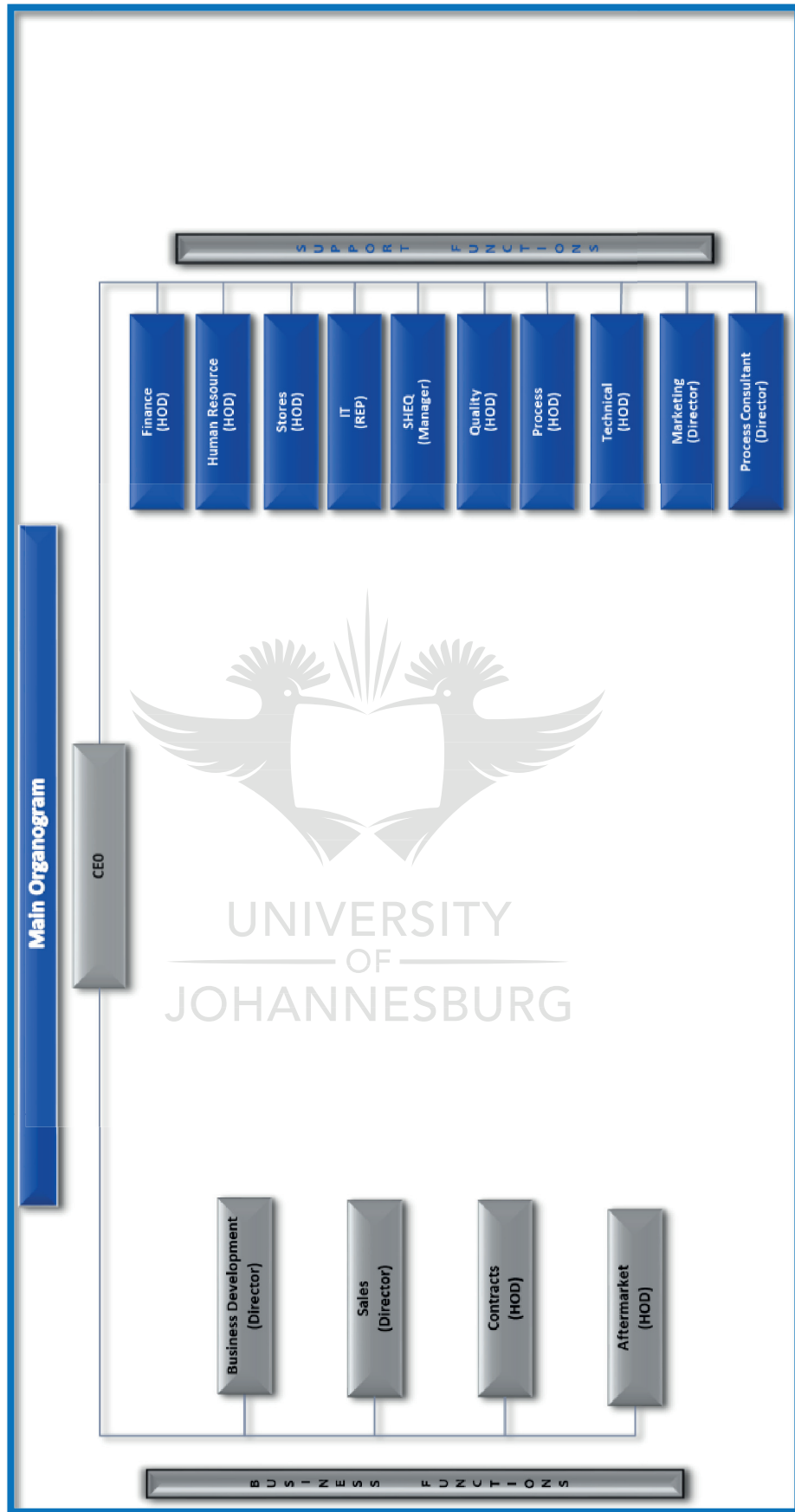


Figure 20: Roytec's higher level organogram

In recent months Roytec has identified the need for change in the organisation to manage the foreseen growth of over R100m in revenue. Due to this, the Contract department structure has changed its structure to the following (including the quality side managed by the same HOD):

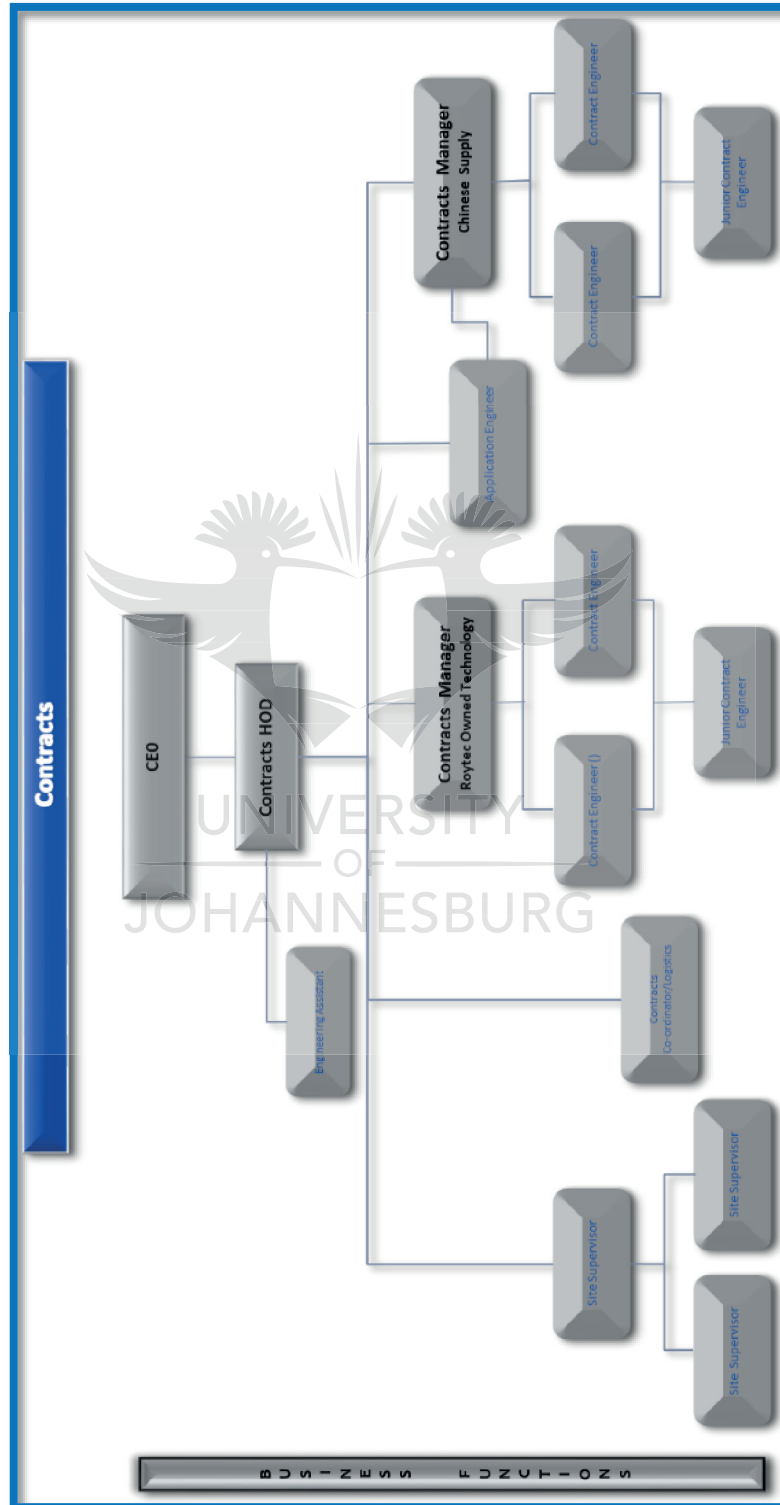


Figure 21: Roytec's Contracts Department current organogram



Figure 22: Roytec's Contracts Department quality structure

### 6.3 Contract Department Procedure

The procedure defined below is to effectively execute all equipment purchase orders and contracts that are received in the Contracts Department (CD). The CD is responsible for the engineering, procurement, delivery, installation and commissioning of equipment in accordance with the relevant laws and standards.

The basic steps of the departmental procedures are (Roytec, 2018):

- The first step to starting the procedure is by receiving an order form a customer
- Next is to nominate a Contract Engineer (CE) for the contract (project) by the HOD
- Then there will be a sales handover to discuss the details of the purchase order and discuss the complete Scope of Work (SOW)
- All technical details will be captured in the Technical Specification document by the Product Champion and handed over to the nominated CE
- The CE is required to ensure that a formal acknowledgement letter is sent to the respective client.
- The CE needs to arrange a kick-off meeting with the client to introduce himself and discuss any items not highlighted during the handover meeting
- The CE will issue formal Work Requests (WR's) along with an updated Technical Specification (Tech-Spec) and Contract Budget to the Head of Department (HOD) for approval
- The CE shall generate the schedule, including design engineering timeframes, procurement, fabrication, assembly, delivery and installation dates and milestones.
- The CE shall compile a Quality Plan and issue to the customer for approval
- The CE must compile a Contract Status Report to summarise the commercial, technical and delivery aspects of the PO for approval by the HOD.
- The CE shall expedite the basic engineering drawings via WR's from the technical department for submission and approval by client before detailed engineering commences. This includes the PID, PFD (when required), GA and engineering lists.
- The CE is required to finalise the Procurement Register and allocate the Scope of Supply to the relevant vendors.
- The CE shall issue Request for Quotation (RFQ) documents for required packages to suppliers and ensure tenders are received by the required date.
- The CE shall complete the adjudication sheet to ensure that quotes are as per the required scope, budget and schedules.

- The CE shall schedule final clarification meetings to finalise any misaligned terms with the nominated supplier.
- The CE shall generate the relevant Purchase Order (PO) Requisition documents for order placement on suppliers
- The Engineering Assistant is responsible for the issuing of the official PO to the relevant suppliers and Quality Manager
- The CE shall arrange a kick-off meeting with the relevant suppliers where required along with the Quality team and client.
- The CE needs to expedite and approve the relevant supplier documentation as per the PO requirements via a formal document transmittal procedure.
- The supplier is required to add these approved document into their Databook for submission to the client.
- The CE is required to ensure that a full spare parts list is submitted with required information to combine and submit to the client
- The CE is required to verify the material receipt at the suppliers and arrange customer inspections, along with invoicing with relevant documentation.
- The CE is further responsible for managing and monitoring the fabrication process to ensure that all standards and specifications are adhered to.
- The CE is responsible for relaying any possible delays to the HOD and finally to the client if the need arises.
- The CE is responsible to ensure that the critically important Factory Acceptance Test (FAT) is completed before equipment is released to the client.
- Along with final release the equipment needs to be disassembled, if required, marked, packed and crated. The CE is responsible to arrange all documentation for transport as well as arranging transport itself.

## 6.4 Observations

The purpose of this section is to evaluate the structure identified in the case study against existing standards

By reviewing the organisational structures above, even with the updated Contract Department structure change, it is clear to see that the organisation still follows a functional layout, as indicated in **Figure 23: Basic Functional organisational structure**. This is evident by the clear split between different departments and all decision making is still reliant on the involvement of the relevant HOD.

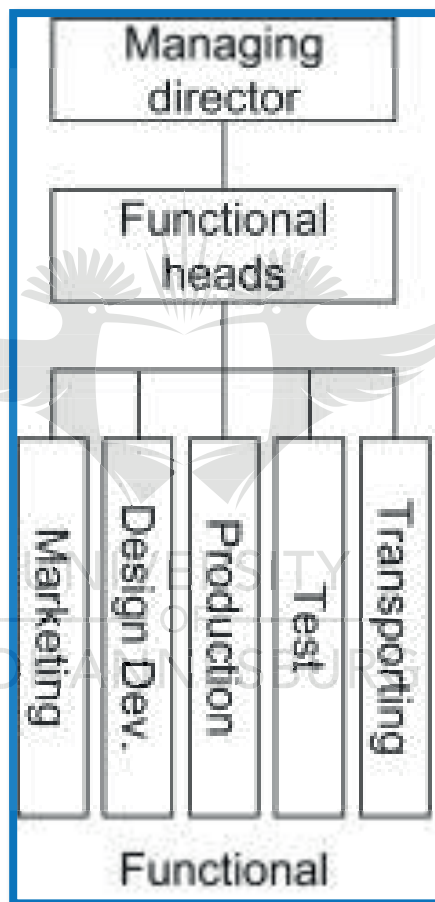


Figure 23: Basic Functional organisational structure (Lester, 2017).

One of the focus points of the organisations in this case study is that it is an organisation mostly focussed on equipment sales, and with that the design, supply and fabrication of these equipment packages are managed as projects. The management by means of projects is a correct decision as they have definite start and end dates with clear goals set by the stakeholder.

By evaluating the management style currently in use, it is clear to identify as the “militaristic” style for communications and decisions moving from the top to bottom. In previous generations this approach has been effective, but in the current innovative era organisations are currently in, this approach only dampens innovations. Currently the CE carries all the responsibility and if any errors occur, the CE is to blame. Because there are no clearly identified team members the accountability of actions is only shouldered by a single person. This does not allow the relevant managers to identify areas where the respective team members may be lacking in and may possibly require training on.

This organisational style and management approach do not readily allow itself to move forward with new innovations or technologies.



## 6.6 Recommendations

The organisational structure and management cultures are not set up for the most efficient delivery of projects. From the research completed earlier in this paper, there are definite shortfalls identified in the current organisational approach and the following three basic recommendations can be made:

### 1. Project management principles

To start any project, according to PMBoK a project charter needs to be generated to clearly identify all the roles and responsibilities of the project manager. This also allows the PM to establish the team best suited for the project itself

The PM's of the organisation, or Contract Engineers as they are referred to, needs to be handed the authority and responsibly to manage their individual teams to ensure the best results are obtained for each project. Each individual team member can still report to their functional heads, which can assist the relevant PM's in scheduling the members for work across different projects as the project progresses past certain stages.

The next major recordation is to generate a clear reporting structure or platform for the projects. The HOD as well as the newly appointed Contract Managers relies on verbal transmission of information and all information to clearly evaluate the project is not automated. The organisation needs to implement a system, like EVPM to ensure that information is accurate and readily available.

### 2. Organisational structure

It is recommended for the organisation structure to move over to a matrix style instead of the current functional style. This will allow the CE / PM's better control over the relevant team members. The will also allow the organisation so better distribute the responsibilities of the workload. This will also assist to ensure that all team members can receive continuous training as areas will clearly identified where they may be lacking.

This structure will also speed up the efficiency of communications as the relevant CE will have more control over the decisions that are required in the project. The structure may also be further broken down to allow for Portfolio Managers that will essentially be the current CM's appointed.



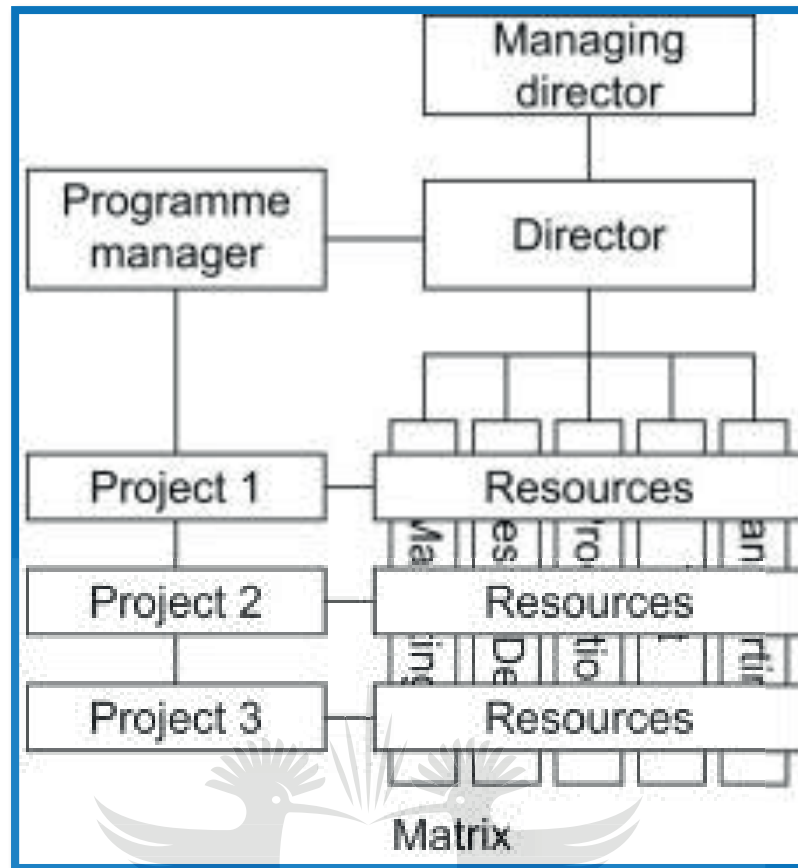


Figure 24: Basic Matrix organisational structure (Lester, 2017).

### 3. Management style

As Engineering Management (EM) is one of the newer fields of engineering, it doesn't have a large set of definitions allocated to it. It is recommended for the management to consider the following points, as highlighted in section 4 of this paper.

To name but a few that needs to be considered and implemented are:

- Systems Thinking
- Communication
- Personal management
- Managing and Motivating Knowledge
- Integrated Management Model
- Operational Management system

#### 4. General

It is also a strong recommendation for the organisation to use a strong financial platform, such as SAGE or SAP, to automate the labour-intensive manual structures. This will allow for a single system to support the organisation financials as well as allow the levels of HOD to CEO to be able to pull reports, such as the EVPM and accurately track each project / contract and status.

This will also allow for coalition between the sales and project teams as budgets and requirements can be preloaded, and any items additionally required can be identified and pre-loaded for future use.



## 7. CONCLUSION

In conclusion there are numerous areas identified that will require more in-depth research that did not form part of this paper. Without this additional required information, the basis formulated can by no means be seen as complete or used as a final proposal.

This paper considered the two main-stream project management philosophies, especially their impact with regards to the organisational structure of project orientated organisations as well as the management of projects and project managers. It is recommended that an organisation implement most if not all the best practices highlighted from these to standards. Although the standards should only be a guideline that needs to be customised to the need of the organisation itself, this will allow the organisation to maximise the success rate of the projects and as well as the profit margins of these projects.

The second consideration of this paper was the different organisational structures and what is best suited for project orientated organisations. In the current South African industry, most organisations lean strongly to a functional organisation, to move over to a pure project orientated structure will be a costly and time-consuming endeavour. It is recommended that organisations start utilising a matrix organisation. This will allow the organisation a smoother transition while still greatly improving the success rate of projects.

The last portion of research this dissertation reviewed more modern types of management styles especially pertaining to the management and impact on projects and project orientated organisations. Depending on the management personalities and organisational it is recommended to incorporate these principles to ensure that the management team as well as organisation stays in trend with the current philosophies.

The final portion of this dissertation reviewed an external organisation in the form of a case study with regards to their project department, the organisational structure and the general management. There are some recommendations that have been discussed with the management of the said organisation and some will be considered soon.

## REFERENCES

- Anantatmula, V. S. (2015). Project Manager Leadership Role in Improving Project Performance. *Engineering Management Journal*, 22(1), 13-22. doi:<http://dx.doi.org/ujlink.uj.ac.za/10.1080/10429247.2010.11431849>
- Andalib, M. S., Tavakolan, M., & Gatmiri, B. (2018). Mohammad Saied Andalib , Mehdi Tavakolan , Behrouz Gatmiri . *International Journal of Project Management*, 600-611.
- Andrews, R., Boyne, G. A., Law, J., & Walker, R. M. (2009). Strategy Formulation, Strategy Content and Performance. *Public Management Review*, 1-22.
- Anice I. Anderson, D. C. (2004). Managing in a Dangerous World—The National Incident Management System. *Engineering Management Journal* , 16(4), 3-9.
- Aubry, M., & Lavoie-Tremblay, M. (2018). Rethinking organizational design for managing multiple projects. *International Journal of Project Management*, 12-26.
- Baker, D. (2018, 07 28). *The 7 Principles of PRINCE2 Project Management*. Retrieved from ByteStart: <http://www.bytestart.co.uk/principles-prince2-project-management.html>
- Blindenbach-Driessen, F., & Van den Ende, J. (2010). Innovation management practices compared: The example of project-based firms. *Journal of Product Innovation Management*, 705-724.
- Brumm, C. A., & Drury, S. (2013). Leadership that Empowers: How Strategic Planning Relates to Followership. *Engineering Management Journal*.
- Carvalho, S. V., Tereso, A. P., & Fernandes, G. (2017). Improving project management practice: An engineering and construction case study. *Industrial Engineering and Engineering Management (IEEM), 2017 IEEE International Conference on*. Singapore.
- Chung, C.-C., Chao, L.-C., & Lou, S.-J. (2016). Constructing the predictive model for strategy execution problems -The application of the two-stage analytic network process. *Journal of Information Hiding and Multimedia Signal Processing*, 184-2016.
- Cristina Rubino, D. R. (2014). Does Teaming Obscure Low Performance? Exploring the Temporal Effects of Team Performance Diversity. *Human Performance*, 27(5), 416-434.
- de Felice, F., Petrillo, A., & Autorino, C. (2014). Maintenance Strategies and Innovative Approaches in the Pharmaceutical Industry: An Integrated Management System (IMS). *International Journal of Engineering Business Management*, 6. doi:<https://doi.org/10.5772/59023>
- Defeo, J. A., & Juran, J. M. (2014). Simplifying Macro Processes with Business Process Management. In *Juran's Quality Essentials for Leaders*. McGraw-Hill Professional.
- Elias, A. A. (2017). Systems Thinking and Modelling for Stakeholder Management. *IIM Kozhikode Society & Management Review*, 123-131.

- Fernandes, G., Ward, S., & Araújo, M. (2015). Improving and embedding project management practice in organisations — A qualitative study. *International Journal of Project Management*, 1052-1067.
- Ford, R. C., & Randolph, W. A. (1992). Cross-Functional Structures: A Review and Integration of Matrix Organization and Project Management. *Journal of Management*, 267-294.
- Frank, M., Zwikael, O., & Boasson, M. (2007). Jobs Requiring a Capacity for Engineering Systems Thinking (CEST): Selection Using an Interest Inventory. *Project Management Journal*, 36-44.
- Gemünden, H. G., Lehner, P., & Kock, A. (2018). The project-oriented organization and its contribution to innovation. *International Journal of Project Management*, 147-160.
- George Geistauts, E. B. (2015). Engineering Ethics: A System Dynamics Approach. *Engineering Management Journal*, 20(3), 21-28.
- Görög, M. (2016). A broader approach to organisational project management maturity assessment. *International Journal of Project Management*, 1658-1669.
- Handfield, R. B., & Lawosn, B. (2007). Integrating Suppliers into New Product Development. *Research-Technology Management*.
- Henman, P. (2016). Techniques and paradoxes in performing performance measurements: concluding reflections. *Policy Studies*.
- Hobbs, B., Aubry, M., & Thuillier, D. (2008). The project management office as an organisational innovation. *International Journal of Project Management*, 547-555.
- Huang, T.-P. (2011). Comparing motivating work characteristics, job satisfaction, and turnover intention of knowledge workers and blue-collar workers, an dtesting a structural model of the variables' relationships in China and Japan. *The International Journal of Human Resource Management*, 22(4), 924-944. doi:10.1080/09585192.2011.555134
- Jacqueline Mayfield, M. M. (2016). Leadership Communication. *International Journal of Business Communication*, 54(1), 3-11. doi:https://doi.org/10.1177/2329488416675446
- Jensen, A., Thuesen, C., & Geraldi, J. (2016). The projectification of everything: projects as a human condition. *Project Management Journal*, 21-34.
- Joan R. Rentsch, L. A. (2014). *The Integrative Team Knowledge Building Training Strategy in Distributed Problem-Solving Teams*. Online.
- Kahraman, C., & Onar, S. C. (2015). Intelligent Techniques in Engineering Management. *Intelligent Systems Reference Library*, p. Volume 87. doi:10.1007/978-3-319-17906-3
- Klus, J. P., & Killingstad, R. (1988). Incorporating technology into new products. *Industry and Higher Education*, 239-243.
- Kuprenas, J. (2003). Implementation and performance of a matrix organization structure. *International Journal of Project Management*, 51-62.

- Kwak, Y. H., Sadatsafavi, H., Walewski, J., & Williams, N. L. (2015). Evolution of project based organization: A case study. *International Journal of Project Management*, 1652-1664.
- Lester, A. (2017). *Project Management, Planning and Control (Seventh Edition)*. Butterworth Heineman.
- Meid, A. (2015). *An Engineering Management Analysis of Communication Management Systems in an Organization that supplies the Mining Industry*.
- Miterev, M., Mancini, M., & Turner, R. (2017). Towards a design for the project-based organization. *International Journal of Project Management*, 479-491.
- Moghaddam, N. B., Nedaei, H., Sahafzadeh, M., & Hosseini, S. H. (2013). A modified strategy formulation model for management technologies in holding companies: A case study of an Iranian conglomerate. *International Journal of Technology Intelligence and Planning*, 57-73.
- Mokoena, T. S., Pretorius, J. C., & Van Wyngaard, C. J. (2013). Triple Constraint Considerations in the Management of Construction Project. *Industrial Engineering and Engineering Management (IEEM), 2013 IEEE International Conference*. Thailand: IEEE.
- Muchiri, P. N., Pintelon, L., Martin, H., & de Meyer, A.-M. (2010). Empirical analysis of maintenance performance measurement in Belgian industries. *International Journal of Production Research*, 5905-5924.
- Naidoo, Y., Pretorius, J., & Marnewick, A. (2015/6). An optimised portfolio management model, incorporating best practises. *IAMOT 2015*. Graduate School of Technology Management, University of Pretoria & Media Chef CC.
- OGC. (2009). *PRINCE2*. TSO London.
- Painter-Morland, M. (2008). Reconsidering ethics management. *Business Ethics as Practice: Ethics as the Everyday Business of Business*, 236-292.
- Pandit, A., & Jhamtani, A. (2011). Growing Leaders Grows Profits - A Case Study in Leadership Development. *Vision*, 15(2), 193-200.
- Payne, J. H. (1993). Introducing formal project management into a traditional, functionally structured organization. *International Journal of Project Management*, 239-243.
- Penide, T., Gourc, D., Pingaud, H., & Peillon, P. (2012). Innovative process engineering: a generic model of the innovation process. *International Journal of Computer Integrated Manufacturing*, 183-200.
- Peterson, J. L. (1996). The New and Old Work Ethic Examined. *Engineering Management Journal*, 8(4), 15-20.
- Philip C. Hicks, D. R. (2015). What are we teaching our Engineering Managers? *Engineering Management Journal*, 11(1), 29-34. doi:<http://dx.doi.org/10.1080/10429247.1999.11415016>
- PMI. (2013). *PMBok (Vol. 5th)*. Project Management Institute, Inc.

- Pretorius, F. I., & Taylor, R. G. (1986). Conflict and individual coping behaviour in informal matrix organizations within the construction industry. *Construction Management and Economics*, 87-104.
- PRINCE2. (2018, 05 26). *A COMPARISON OF PRINCE2 AGAINST PMBOK*. Retrieved from PRINCE2.com: <https://www.prince2.com/zar/downloads>
- PRINCE2 Wiki. (2018, 07 27). *PRINCE2 Process Model*. Retrieved from PRINCE2 Wiki: [http://prince2.wiki/PRINCE2\\_Process\\_Model](http://prince2.wiki/PRINCE2_Process_Model)
- Rebelo, M. (2014). Conception of a flexible integrator and lean model for integrated management systems. *Total Quality Management & Business Excellence*, 25(5-6), 683-701.
- Robinson, D. (2018, 07 27). *Business Case*. Retrieved from TECH Academy: <https://p2.tech-academy.co.uk/business-case/>
- Rohrbeck, R., & Gemünden, H. G. (2011). Corporate foresight: Its three roles in enhancing the innovation capacity of a firm. *Technological Forecasting and Social Change*, 231-243.
- Roytec. (2018, 01 15). Contracts Department Procedure. *Document Identification no. : RP 002\_009 (3)*. Johannesburg, Gauteng: Roytec.
- Roytec. (2018, 06 01). *Roytec - Home*. Retrieved from Roytec: <http://www.roytec.co.za/>
- Roytec. (2018, 07 01). *Roytec - Services*. Retrieved from Roytec: <http://www.roytec.co.za/services/>
- Roytec. (2018, 07 01). *Roytec - Skills*. Retrieved from Roytec: <http://www.roytec.co.za/skills/>
- Scott, S. T. (2015, 07 13). *PMBOK Process Map (5th Edition)*. Retrieved from Professional musings of an over-active mind: <https://seantscott.wordpress.com/2015/07/13/pmbok-process-map-5th-edition/>
- Senarante, S. (2015). Application of team role theory to construction design teams. *Architectural Engineering and Design Management*, 11(1), 1-20.
- Senge, P. M. (n.d.). *The Fifth Discipline*.
- Shaked, H., & Schechter, C. (2016). Holistic School Leadership: Systems Thinking as an Instructional Leadership Enabler. *NASSP Bulletin*, 177-202.
- Singer, J. F., & Brown, S. M. (1991). Strategic Management Planning in Consulting Engineering. *Engineering Management Journal*.
- Singh, A. (1996). Examination of an Emerging Consiousness in Engineering Management. ASCE.
- SmartSheet. (2018, 02 24). *The Triple Constraint: The Project Management Triangle of Scope, Time, and Cost*. Retrieved from SmartSheet: <https://www.smartsheet.com/triple-constraint-triangle-theory>
- Tucker, W. (2017). Crossrail project: The execution strategy for delivering London's elizabeth line. *Proceedings of the Institution of Civil Engineers: Civil Engineering*, 3-14.

- Turner, R. J. (2018). The management of the project-based organization: A personal reflection. *International Journal of Project Management*, 231-240.
- Ugboro, I. O., Obeng, K., & Spann, O. (2011). Strategic Planning as an Effective Tool of Strategic Management in Public Sector Organizations: Evidence from Public Transit Organizations. *Administration & Society*.
- van Dyk, D. J., & Pretorius, L. (2014). A systems thinking approach to the sustainability of quality improvement programmes. *South African Journal of Industrial Engineering*, 71-84.
- Van Wyngaard, C. J., Pretorius, J. C., & Pretorius, L. (2012). Theory of the triple constraint—A conceptual review. *Industrial Engineering and Engineering Management (IEEM), 2012 IEEE International Conference* (pp. 1991-1997). Hong Kong: IEEE.
- Vertenten, M., Pretorius, J. C., & Pretorius, L. (2012). *The use of earned value as trend analysis tool for construction projects in South Africa*. Johannesburg: <http://hdl.handle.net/10210/7399>.
- Walden, T. (2008). The Matrix Organisation. *Administration in Social Work*, 31-42.
- Wright, K. N. (2005). Designing a national performance measurement system. *The Prison Journal*, 368-393.
- Yunting, T. (2012). The study on human resource management performance evaluation based on data envelopment analysis and analytic hierarchy process. *International Journal of Digital Content Technology and its Applications*, 256-265.



APPENDIX A

Table 3: Key Differences between PMBOK and PRINCE2 ( (PRINCE2, 2018)).

Chapter	PMBOK Summary	PRINCE2	Comments by WeBrite
Ch1 Introduction	This says that the purpose is to identify and describe that subset of the PMBOK that is generally accepted, i.e. has widespread consensus about their value and usefulness. There is no indication of what else is in PMBOK outside the subset. It also aims to provide a common lexicon of project management terms.	No clash with PRINCE2	PMBOK goes into more detail about its overlap with other management areas, whereas PRINCE2 simply says 'we don't try to reinvent the wheel'
What is a project?	A general and familiar description of a project's characteristics	No contention with PRINCE2	
What is Project Management?	After a general description there is a reference to the 12 chapters of the guide in sections I and II.	The 12 chapters are discussed in greater detail later in the comparison	
Relationship to other Management Disciplines	This touches very briefly on areas where there is overlap between PMBOK and General Management (e.g. planning, staffing, law, logistics) and Application Area Knowledge (e.g. software development, government contracting, marketing)	PRINCE2 specifically avoids most of these overlaps.	
Related Endeavours	This is mainly a discussion of the relationship of projects to programs and sub-projects	No contention with PRINCE2. PMBOK sub-projects relate to Work Packages and the Project Manager and a team.	
Ch.2 The Project Management Context			
Project Phases and the Project Life Cycle	Discussion of phases linked to decision points to review key deliverables and project performance to date. Several examples are given of Representative Project Life Cycles.	PRINCE2 uses the word 'stage' rather than 'phase' but same concept. PMBOK makes the same distinction between project and product life cycles as PRINCE2. The examples of life cycles are what PRINCE2 would call 'technical stages', but these may well match PRINCE2	
Project Stakeholders	This defines the term 'stakeholder' and gives examples of who they might be. It makes the point that stakeholders may have different objectives	No major difference to PRINCE2, although PMBOK includes the Project Manager and team members as stakeholders, whereas the interpretation in PRINCE2 stays at a higher level and gives examples of stakeholders outside the project management team.	
Organizational Influences	This discusses the possible impact of the overall organization within which the project operates. Several organizational structures are described.	PRINCE2 has the same approach but doesn't go into it in the detail of examples that PMBOK does	PMBOK briefly discusses two organizational cultures and how a project might benefit from or clash with its organization's culture.
Key General Management Skills	This describes key general skills that a Project Manager needs, including leading, communicating, negotiating, problem solving and influencing the Organization	PRINCE2 does not attempt to cover these skills.	The PMBOK simply describes in brief terms what each of the skills is, without offering any approach to them or relating them to the PMBOK aspects where they will be useful.
Social-Economic-Environmental Influences	This simply says that a Project Manager must be aware of current conditions and trends in Standards & Regulations, Internationalization, Cultural Influences and Socio-Economic Environmental Sustainability	PRINCE2 does not cover these topics	PMBOK says nothing about when or how to handle the influences, just gives examples of what they might be
Ch3 Project Management Processes			
Project Processes	This is a brief mention that a project is composed of processes, to be expanded in chapters 4 – 12.	No contention with PRINCE2. The PMBOK terms of 'project management processes' and 'product-oriented processes' relate to PRINCE2's concepts of management and technical stages.	
Process Groups	PMBOK talks of 5 groups of one or more processes each; initiating, planning, executing, controlling and closing.	These relate to the PRINCE2 processes plus some of the Components, such as Plans and Controls, and the linkages between them.	The PRINCE2 processes are more clearly separated for understanding and the 8 processes provide more detail than the 5 PMBOK groups
Process Interactions	This talks the 5 process groups and describes them in terms of their inputs, outputs, tools and techniques. PMBOK also has a process for Team Development. The Controlling process group covers change control, performance reporting, quality control, risk monitoring and control. An unusual process in this group is Scope Verification, described as 'formalizing acceptance of the project scope'. The Closing process group covers Contract Closeout and Administrative Closure.	PRINCE2 provides the inputs and outputs and also shows where Components and Techniques are used in the processes. The two Planning processes are very similar, and there are similar links between Planning and the Management of Risk. The PMBOK Executing processes contain several elements that refer to procurement, such as solicitation, source selection and contract administration. PRINCE2 does not cover Team Development. The Controlling process group's work is covered by the CS and MP processes. The Closing process is very similar to the CP process.	PMBOK talks of initiating a project or a phase. This equates to PRINCE2's initiation stage/process and Managing Stage Boundaries. Whilst procurement may be part of many projects, not all projects will want a method so specifically linked to procurement. 'Scope Verification' in PRINCE2 would be part of the initiation process, which correctly places it at the outset of a project, less confusing than the PMBOK's placement of it.
Customizing Process Interactions	A simple explanation that the standard processes should be tailored for a project's needs.	No contention with PRINCE2.	
Mapping of Project Management Processes to the 9 project management knowledge areas	A matrix is given, mapping the 39 project management processes of the 5 process groups to the 9 project management knowledge areas	This is similar to mapping PRINCE2 processes to the components and techniques.	No major difference, although here again we see Solicitation, Source Selection and Contract Administration coming in.

Section 1 The Project Management Framework

Chapter	PMBOK Summary	PRINCE2	Comments by Website
Ch. 4 Project Integration Management	This covers the processes required to ensure coordination of the various project elements, specifically plan development and execution plus change control	PRINCE2 mentions a WBS, rather than Product Breakdown Structure. There is no mention in PMBOK at this time of Stage or Team Plans, nor any detail of how to create the plan, just what it should contain	PMBOK talks of many subsidiary management plans, such as scope management plan, quality management plan, communications management plan, risk response plan. Many of these are covered in other sections of the PID
Project Plan Development	There is a general discussion on creating a Project Plan and using Earned Value Management, although no detail is given here about it.	PRINCE2 goes down to Stage and Team Plan level for day-to-day execution. Work Packages match work authorization, but far more detail is given of the content of the WIP and the interface with Team Managers. PRINCE2 has Checkpoint meetings but specifically suggests that the Project Board meetings by exception and receive Highlight Reports instead of holding review meetings, except for end stage assessments. The PRINCE2 CS2/3/4 processes give far more detail about gathering progress information, capturing and examining change requests.	PMBOK is vague here, stays at a high level of plan for day-to-day control, and still has regular progress meetings without separating Project Board from these.
Project Plan Execution	This takes the approach that a project is managed against the Project Plan on a day-to-day basis. Work authorization and status review meetings are mentioned. There is only a brief mention of change requests and gathering information on work results	PRINCE2 offers a detailed change control approach and far more detail on configuration management	
Integrated Change Control	This provides an overview to change control and configuration management. No detail, no method of how to do it is offered.	PRINCE2 covers scoping in both the PID and Work Package	The PMBOK states that this chapter will cover the tools and techniques required, but the only one covered in any detail is the WBS, and there is no effort to continue from that planning point into the other techniques needed to actually produce a plan
Ch. 5 Project Scope Management	This covers the scoping of a project or phase and controlling any changes to that scope.	PRINCE2 tackles this in three areas: project initiation, Managing Stage Boundaries and Directing a Project. Project selection methods equate to the PRINCE2 Project Approach, benefit measurement would be found in the PRINCE2 Business Case and the list of those offering expert judgement would be available to any team member. The PID equates to the Project Charter, but is wider in scope, e.g. identifying the whole project management team, not just the Project Manager, including the Project Plan, Business Case, risk evaluation and control.	PRINCE2 talks of a Product Description as input to initiation, but this is not the same as a PRINCE2 Product Description. It covers the product characteristics, the relationship between the product and the business need, and the 'form and substance' of the product description may vary.
Initiation	Initiation is taken as the initiation of a project or the authorization to continue into the next phase. It mentions tools and techniques, such as project selection methods, benefit measurement methods mathematical methods and expert judgement – no specific method is offered, just a list of possible sources. The output is a Project Charter.	PRINCE2 has this as part of the PID, being Problem Definition. The management of scope change is dealt with in PRINCE2 by change control, whose method is described as part of the Project Quality Plan in the PID. In PRINCE2 an assessment during initiation of the volume of change expected leads to consideration of a Change Authority and Change Budget.	It seems odd that this comes after the Project Charter, whereas PRINCE2 makes it part of the information needed before authorizing the project. One of the tools mentioned by the PMBOK is benefit/cost analysis, although there is no specific output of a Business Case. PMBOK does not enlarge upon the scope management plan to discuss what to do if the assessment shows a large volume of expected changes.
Scope planning	This covers the 'progressive elaboration' of project scope. The inputs are the Product Description, the Project Charter and the initial definition of constraints and assumptions. The outputs are the Scope Statement and Scope Management Plan. The latter describes how scope change will be managed and includes an assessment of the expected stability of the project (how likely to change, how frequently and how much)	This equates to part of the PRINCE2 Product-based Planning technique, the Product Breakdown Structure, without the quality aspect of writing Product Descriptions or the transfer of the products into a Product Flow Diagram. The Planning process contains much more detail in taking the Product Breakdown Structure through the Product Flow Diagram, estimating, scheduling, risk assessment and writing a narrative.	When describing other types of WBS, PMBOK refers to a PBS, meaning a Project Breakdown Structure, as being 'fundamentally the same as a properly done WBS'.
Scope definition	This is the subdivision of the major project deliverables into smaller, more manageable components. The outputs are work breakdown structures, PMBOK offers three example templates covering an aircraft system, a software product release and a wastewater treatment plan. The process stops at 'decide if adequate cost and duration estimates can be developed at this level of detail for each deliverable.'	This is dealt with in more depth by the CP and DPS processes. PMBOK only has formal acceptance as an output.	
Scope verification	This is described as 'the process of obtaining formal acceptance of the project scope by the stakeholders'. It refers to the acceptance of the work results, i.e. occurs at the end of a project, rather than agreement at the end of initiation on what is to be done.	PRINCE2 has both a change control component, a change control technique, processes (CS3 and CS4) to capture and analyse change requests and a series of processes to obtain decisions on changes and manage their implementation (CS5, CS6, Exception Report, DP4, SB6, Exception Plan and DP3 – Project Board decision on a revised plan)	There is no mention in the PMBOK process of an End Project Report or a Post Project Review Plan.
Scope change control	This is a very high level view of the need for change control, agreeing and managing scope change.	PRINCE2 (drawing a Product Flow Diagram), PL3 (Activities and Dependencies), PL4 (Estimating) and PL5 (Scheduling) cover this.	Both methods include noting lessons learned from changes and setting a new baseline.
Ch. 6 Project Time Management	This covers the development of the project time schedule	Covered by the second step of PL2 and the first part of process PL3. The activity description equates to a Product Description without offering a disciplined structure for it.	
Activity Definition	Identifying and documenting the specific activities required to produce the deliverables shown in the WBS. Part of the activity list should be descriptions of each activity to ensure that the project team members will understand how the work is to be done.		

Section 11 The Project Management Knowledge Areas

Chapter	PMBOK Summary	PRINCE2	Comments by Website
Activity Sequencing	The identification and documentation of interactivity logical relationships. This suggests network planning as a tool.	Covered by the last step of PL2 (drawing a Product Flow Diagram) and the second half of process PL3. PRINCE2 also suggests network planning software tools.	
Activity Duration Estimating	Estimating both the work periods required to complete an activity and the elapsed time.	This is covered by PL4	PMBOK gives an overview of four methods of estimating, but not enough to be able to use them.
Schedule Development	The iterative process of determining start and finish dates	Covered by PL5	PMBOK has the risk management plan as input, but does not consider updating risks as a result of planning
Schedule Control	a) Influencing the factors that create schedule changes to ensure that changes are agreed upon (b) determining that the schedule has changed and (c) managing the actual changes when and as they occur. It includes performance measurement, i.e. tracking plan changes that occur for other reasons than change requests.	Covered in greater detail in the change control approach, processes such as CS2/3/4/5/7 and 8, and products such as Project Issues and Exception Reports and Plans.	Both methods include updating Lessons Learned.
Ch 7 Project Cost Management	This includes the processes required to ensure that the project is completed within the approved budget. The first three steps are part of the planning process. The last process covers controlling changes to the project budget and is almost a mirror image of 6.5 Schedule Control, looking at cost instead of time.	PRINCE2 sees the first three as a minor part of PL5, Scheduling. The final part, Cost Control, is handled by the PRINCE2 approach to change control and the CS processes, as described against Schedule Control.	PMBOK goes into more detail than PRINCE2 in most of this area with the exception of handling tolerances, a topic that PRINCE2 covers in much more detail in the Controls component, SB/DPS (agreement with the Project Board on stage tolerances) and CS/7 and 8.
Resource Planning	This covers determining what physical resources should be used.	PRINCE2 sees this as part of PL5, Scheduling	
Cost Estimating	This covers the estimate of the costs of the resources needed to complete project activities. One output is a cost management plan, stating how cost variances will be managed.	PRINCE2 covers this very briefly, but does not separate this from the other aspects of Scheduling. Cost variances are dealt with as part of tolerances and their control, and this area is dealt with more thoroughly by PRINCE2.	
Cost Budgeting	This covers the allocation of the overall cost estimates to individual work packages	Again this is part of PL5, Scheduling	
Cost Control	Watching for the impact on cost of proposed change requests and other reasons for plan slippage. The process refers to Earned Value Management as a tool for measuring project performance.	Covered by CS2, Assessing Progress, CS4, Examining Project Issues and the escalation process	PRINCE2 does not include EVM or any other tool for performance management, but works happily with any such tools used. Both methods mention updating Lessons Learned. The process mentions that processes should be developed for the closing or cancelling of projects. PRINCE2 provides such procedures.
Ch 8 Project Quality Management	This includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. This covers the quality policy, objectives, responsibilities, quality assurance, quality control and quality improvement within the quality system. The chapter is intended to be compatible with ISO 9000, TQM and Continuous Improvement		Both methods recognize customer expectations, prevention over inspection and management responsibility.
Quality Planning	This involves identifying what quality standards are relevant to the project and determining how to satisfy them. The main output is a quality management plan.	This is fully covered in PL1, Planning Quality. PRINCE2 also offers a process, SU4, where the customer's quality expectations are sought and recorded. The Project Quality Plan is the equivalent of the quality management plan.	PMBOK does not formalise the customer's quality expectations
Quality Assurance	PMBOK uses the phrase to cover 'all the planned and systematic activities implemented within the quality system to provide confidence that the project will satisfy the relevant quality standards'. It covers reviews of quality results and audits of the other quality management activities.	PRINCE2 separates the organisation-wide quality assurance role – setting and monitoring the use of standards – from aspects of the Project Assurance role, the planning of resources for quality work and monitoring the results for a single project. PRINCE2 offers a quality file for all quality documents, which can be used for quality audits.	PRINCE2 accepts that there may be audits from an organisation-wide quality assurance group, independent of the project, but also offers a role for this group as part of Project Assurance.
Quality Control	This involves monitoring specific project results to determine if they comply with relevant quality standards.	PRINCE2 covers the need in products and techniques such as the Quality Log and quality reviews	Both cover the quality of products and project management. PMBOK does include a description of Pareto diagrams
Ch 9 Project Human Resources Management	PMBOK makes reference to such human factor skills as leading, delegating, team building and performance appraisal without going into detail or recommending any specific methods.	PRINCE2 does not cover this aspect.	
Organizational Planning	This covers identifying, documenting and assigning project roles, responsibilities and reporting relationships	PRINCE2 covers this in SU2 and SU3, designing and appointing the project management team. PRINCE2 also offers a project management organisation structure with standard descriptions for each role to be tailored for each specific project, compared to PMBOK's discussion of an organisation chart	PRINCE2 covers the area in far more detail and is more specific about the roles that should be considered. PMBOK says that roles may be assigned to individuals or groups.
Staff Acquisition	This covers negotiation, pre-assignment and procurement of resources.	PRINCE2 does not cover this.	
Team Development	This considers team building, personal training, reward and recognition systems.	PRINCE2 does not cover this	PMBOK mentions the importance of these things and then points the reader to 'a substantial body of literature' on the topic as opposed to detailing how they are to be achieved.

Chapter	PMBOK Summary	PRINCE2	Comments by Website
Ch 10 Project Communications Management	This covers the timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information. This involves determining the information and communications needs of the stakeholders.	PRINCE2 describes the products, offers Product Descriptions of them and the processes where each type of communication is generated and used. This is covered by the Communication Plan, part of the PID.	Both methods link communications to the organizational structure.
Communications Planning	This covers the implementation of the communications management plan as well as responding to unexpected requests for information.	The implementation is embedded in the relevant processes, such as reporting highlights, preparing and stage reports. The Project Issue procedure covers any unexpected requests for information.	
Information Distribution	This involves the collection and dissemination of performance information, plus the maintenance of the data in an organized fashion.	This is covered in such processes as CS2, Assessing Progress and CS6 Reporting Highlights. PRINCE2 offers a filing structure in which to keep the information.	PMBOK describes the Earned Value Analyst technique.
Performance Reporting	This covers the documentation of results to formalise acceptance of the product and the archiving of project records.	This is fully covered in the CP process, Closing a Project. PRINCE2 is more specific about what the documents should be and what they should contain.	
Administrative Closure	The systematic process of identifying, analysing and responding to project risk.	The Management of Risk component fully covers this.	PRINCE2 can work equally well with the risk approach that it describes or any other risk management method
Ch 11 Project Risk Management	This covers deciding how to approach and plan the risk management activities for a project.	PRINCE2 assumes that the same approach to the management of risk will be used on all projects.	One thing covered in the PMBOK is risk budgeting. The new version of PRINCE2 will include this and the use of risk tolerance, also mentioned briefly in the PMBOK.
Risk Management Planning	Determining which risks might affect the project and documenting their characteristics. It discusses techniques such as brainstorming and Delphi.	Covered by the Management of Risk component.	
Risk Identification	Assessing the impact and likelihood of identified risks	Covered as above. PRINCE2 offers the Risk Log to assist in monitoring risks.	
Qualitative Risk Analysis	The numerical analysis of the probability and impact of a risk. Sensitivity and decision tree analysis are briefly described	PRINCE2 suggests high, medium and low scoring, but is equally at home with a scoring system. No analysis techniques are discussed.	PMBOK goes into more detail in identifying realistic cost, schedule or scope targets.
Quantitative Risk Analysis	This covers the development of options to counteract risks, including the assignment to individuals to take responsibility for each agreed risk response.	The consideration of options is covered in Evaluation. PRINCE2 discusses the balance of the impact of the risk occurring against the impact of taking the possible risk actions. PRINCE2 covers the assignment of risk actions as part of risk management. PMBOK talks of a Risk Register. PRINCE2 uses the term Risk Log.	Both methods offer the same types of risk action and mention the appointment of risk owners. There is a description of residual risks and secondary risks in the PMBOK, not covered in PRINCE2.
Risk Response Planning	Keeping track of identified risks and identifying new ones, ensuring the execution of plans and evaluating their effectiveness in reducing risk.	Covered in the four steps of risk management; planning, resourcing, monitoring and control. PRINCE2 also lists these to the points in the various processes where they occur.	
Risk Monitoring & Control	This covers the processes to acquire goods from outside the customer organisation.	Most of this is not covered. PRINCE2 regards this as a specialist activity, rather than a generic part of project management.	
Ch 12 Project Procurement Management	This is the process of identifying which project needs can be best met by procuring products or services outside the project organisation. It includes an overview of make-or-buy analysis and contract type selection	This would be part of defining the Project Approach in 'Starting up a Project', although PRINCE2 keeps this at a high level.	
Risk Monitoring & Control	This covers the preparation of documents needed in order to approach prospective suppliers, including evaluation criteria.	Not covered	
Procurement Planning	This covers the obtaining of bids and other responses from prospective suppliers, including any qualified seller lists, bidder conferences and advertising	Not covered.	
Solicitation Planning	This covers from the receipt of bids and the application of the evaluation criteria to the selection of a provider, including contract negotiation	Not covered	
Solicitation	This is the process of ensuring that the seller's performance meets contractual requirements	PRINCE2 covers all aspects of this; the planning interfaces between Project Manager and Team Manager of Work Packages and Team Plans, performance reporting (Checkpoint Reports), quality control (the Quality Log) and change control, except for the payment system, although payments can be linked to product approval or end stage assessments.	
Source Selection	This is similar to administrative closure, described earlier. It involves both product verification and the updating of records and their archiving	As PRINCE2 considers procurement is a specialist activity, it does not cover this as such. But all its requirements are covered by the CP, Closing a Project, and DPS, Confirming Project Closure, processes	
Contract Administration			
Contract Closure			

Chapter	PMBOK Summary	PRINCE2	Comments by Website
Section III Appendices			
A. The Project Management Institute Standards Setting Process	This defines what the PMI standard documents are, the handling of the development of original works and adoption of non-original work as standards.	There are PMBOK-specific and do not concern PRINCE2.	
B. Evolution of PMI's 'A Guide to the Project Management Body of Knowledge'	A history of the evolution of the PMBOK plus lists of the standards committee, contributors, reviewers and production staff.		
C. Contributors and Reviewers of PMBOK Guide 2000 Edition	This lists the contributors and reviewers of the current edition.		
D. Notes	Where applicable this lists the sources of information used in the various chapters, such as The American Heritage Dictionary of the English Language.		
E. Application Area Extensions	An Application Extension Area is where there are generally accepted knowledge and practices for a category of projects in one application area that are not generally accepted across the full range of project types. The Appendix covers the need for these, criteria for their development, the publication and format of them and the process for development and maintenance of them. No examples are given.		
F. Additional Sources of Information on Project Management	This lists a number of professional and technical organisations, some commercial publishers, a reference pointer to a website for The PMI Registered Education Provider Program and a very vague mention that many educational institutions offer project management education.		
G. Summary of Project Management Knowledge Areas	This is a summary of the topics of sections I and II.		
Glossary	This holds: A description of the glossary inclusions and exclusions; A list of common acronyms; Definitions of project management terms	PRINCE2 terminology is not included, except where both use a common term.	

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